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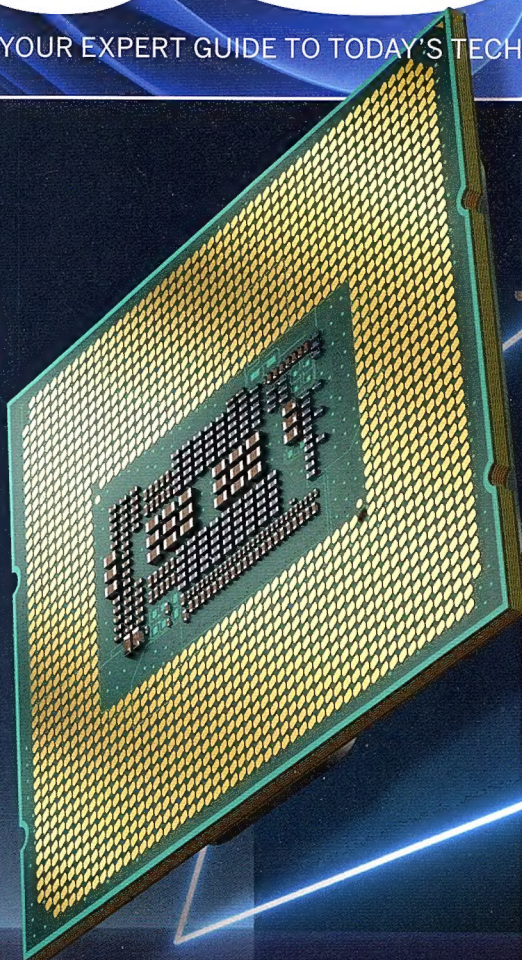
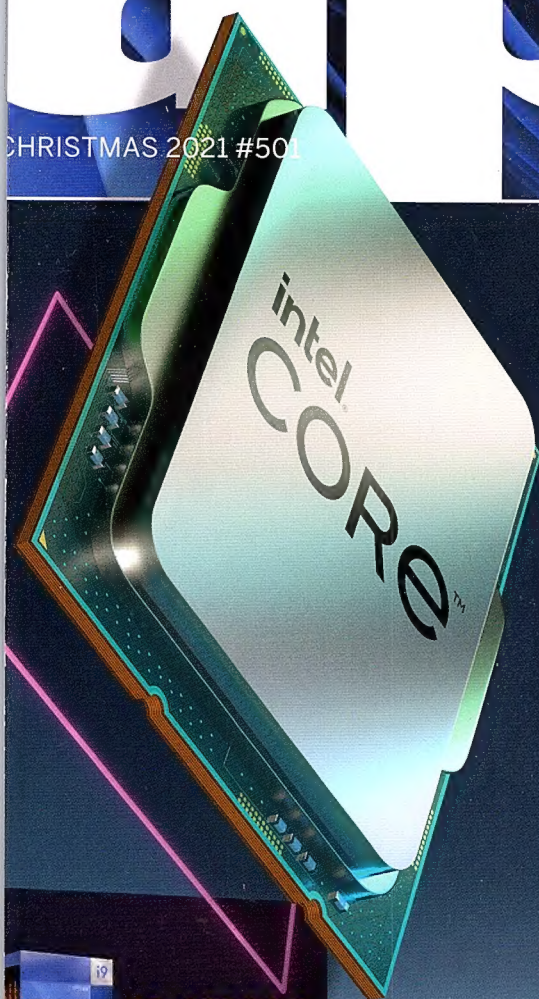
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CHRISTMAS 2021 #501

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IS THIS THE PERFECT
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**i5-12600K &
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INSIDE THE ALL-NEW DESIGN + WHAT TO EXPECT FROM Z690 BOARDS, PCIE 5.0 AND DDR5

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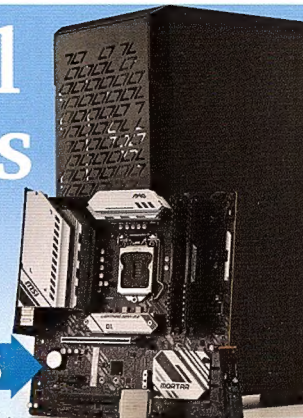
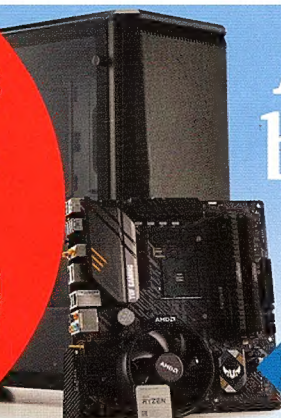
**RUN WINDOWS
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YOUR M1 MAC**

**TURN YOUR
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AMD vs Intel budget builds

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Vigor2865 Series

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- 1 x USB 2.0 port for 3G/4G LTE USB modems, FTP server, network printer or thermometer
- 5 x Gigabit LAN ports with multiple subnets for up to 60,000 NAT sessions
- 32 x VPN tunnels (including 16 x OpenVPN/ SSL-VPN tunnels) with most security protocols
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- Central Switch Management for up to 10 VigorSwitches
- 2 years back to base warranty



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INTRO

EDITORIAL

WHAT'S INSIDE APC



EDITORIAL

IT'S ON

Your CPU choices just got really, really interesting.



BEN MANSILL

Ben loves it when two industry giants face off in a battle to make the most incredible tech possible.

I am so incredibly happy Intel is properly competitive again, and taking it toe-to-toe with AMD. It's the best news possible for driving innovation forward, and – as I expect we'll see soon – prices down.

Is Intel #1 again? Well... it depends. Arguably, yes it is – at least today with pricing as it is. At a bare minimum this all means Intel is a serious option for your first choice. And depending on your tasks, it could be the better option.

The Big/Little hybrid design still needs time to prove its real world value, and further, if this is the new way forward for desktops and Windows laptops, is AMD compelled to follow suit? Remember, ARM-based designs – which now includes Apple's M1 – have been kicking winning goals with this architecture for a very long time. Could AMD's revolutionary chiplet architecture that catapulted it to the top spot now be a yoke that needs to be revised? Can AMD integrate little cores into the Zen 4 architecture – has it been working along those lines for the last couple of years and that's what we're about to see when it launches? Or are they even needed, with AMD's core-count numerical superiority?

In terms of market release timing, the advantage isn't necessarily back with AMD, either, in terms of now knowing what its up against. There's a reasonable chance Intel's 13th gen Raptor Lake could be out before Zen 4. Is AMD's honeymoon over? Let's not forget that the ultimate HEDT performance crown still sits upon AMD's Threadripper, and that its Zen 3 refresh adding V-Cache – which could provide a performance boost of up to 15 percent (AMD's claim) – could see a red nose ahead in the race as soon as January.

Right now AMD is in a great place, regardless of how competitive Alder Lake is. Its x86 market share is the highest it's been since the glory days of the Athlon 64, back in 2006, thanks to an extremely strong Q3 financial result, and it currently holds just over 24 percent total market share. Its momentum will surely be dampened now, but it takes a long time for significant changes in day-to-day sales to reflect in overall market data – which is why Intel still holds three quarters of the market share, even though by almost any metric Ryzen CPUs were bought in most cases by enthusiasts and gamers for at least the last two years.

Both companies have chosen a decidedly different engineering and design direction. Intel has the bank on its new hybrid architecture, while AMD has bet the farm on chiplets and 3D stacking. Remember when frequency was all that mattered? Wow, eh?

BEN MANSILL

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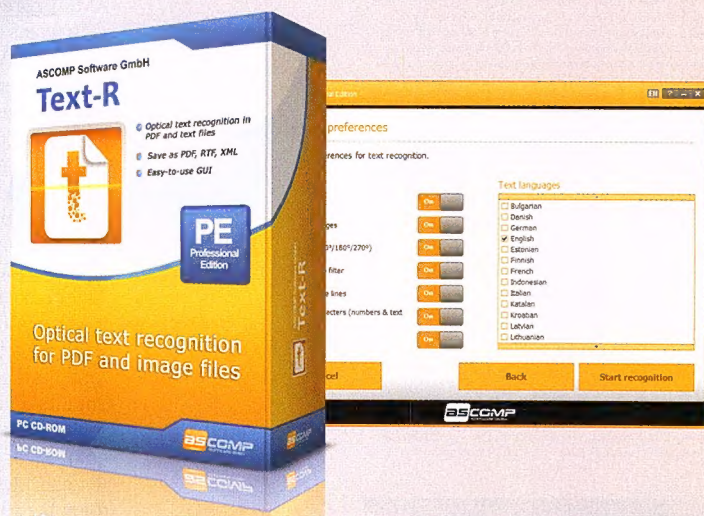
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Exploit Blocker

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LiveGuard

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Gamer Mode

Secures your device & protects your data without distracting pop-ups



ESET protects 1.3 billion people globally in over 200 countries, including Google Chrome users

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12TH GEN IS HERE!

INTEL'S GIANT LEAP FORWARD

INSIDE THE ALL-NEW DESIGN + WHAT TO EXPECT FROM Z690 BOARDS, PCIE 5.0 AND DDR5



SUPERGUIDE

Windows 11 help, tips & tricks

Microsoft's big, new and free OS is out, and here's how to get started. **Page 63**



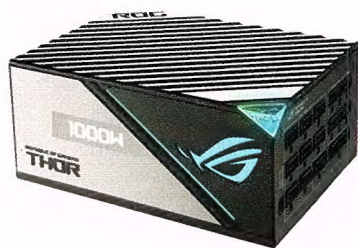
AMD ← vs → INTEL

Two budget PCs go head-to-head in an epic integrated graphics PC build-off. **Page 80**



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Apple's new M1 Pro and Max processors pack a punch, but is the 2021 MacBook Pro really the perfect package? **038**



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“Championing technology doesn’t mean we’re unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage.”

HOW WE DO IT

Inside APC

Find out all about APC’s editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia’s oldest consumer technology magazine – having been consistently in print for forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

We’re also an open church in terms of platforms. We know most people aren’t wed to a single brand’s products and use a variety of devices. And, like you, APC’s journalists want to know what’s good in tech – no matter what platform it resides on.

Independent reviews

Championing technology doesn’t mean we’re unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we’ve flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter offers better ease-of-readability, but tables are more compact, so we use these in most cases where thoroughness is preferred. ■

APC TESTBED

The current APC testbed used in the Labs for benchmarking all components. This testbed is updated as new and relevant technology comes on stream.

CPU	AMD Ryzen 7 5800X
Motherboard	Asus ROG Crosshair VIII Dark Hero
GPU	Zotac RTX 3080 Ti AMP Extreme Holo
Memory	Crucial Ballistix Sport DDR4-3600 2x16GB
Primary SSD	Adata S70 2TB NVMe
Secondary SSD	Samsung 980 Pro 500GB NVMe
Cooling	Nzxt X73 360mm AIO
Case	Thermaltake Core P8
Power Supply	Corsair AX1000

APC AWARDS



APC EDITOR'S CHOICE
When a reviewed product scores 4.5 out of 5 or higher, it carries the Hot Award. These are products that exceed expectations and deliver a quality experience up there with the very best.



APC HIGHLY RECOMMENDED
You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

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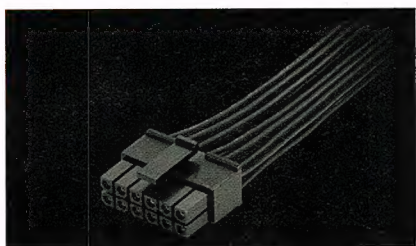
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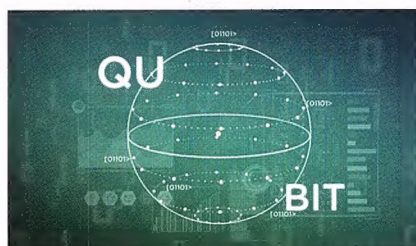
NVIDIA'S 12-PIN PLUG FOR PCIe 5.0 GPUS

Are you ready for 600W+ GPUs?

It would appear that Nvidia's 12-pin PCIe power connector may be here to stay. According to Asus' marketing for the latest ROG Thor II power supplies, the Nvidia 12-pin connector complies with the PCIe 5.0 specification.

During the brand's Z690 motherboard livestream, Asus highlighted the importance of power supplies, as graphics cards are constantly drawing more and more power. Using the GeForce RTX 3090 as an example, Asus claimed that the Ampere-based flagship peaks up to 900W during gameplay, thus requiring power supplies with higher wattage. More importantly, Asus declared that Nvidia's 12-pin connector is PCIe 5.0 ready and that the new ROG Thor II units will ship with "Gen 5 12-pin connectors."

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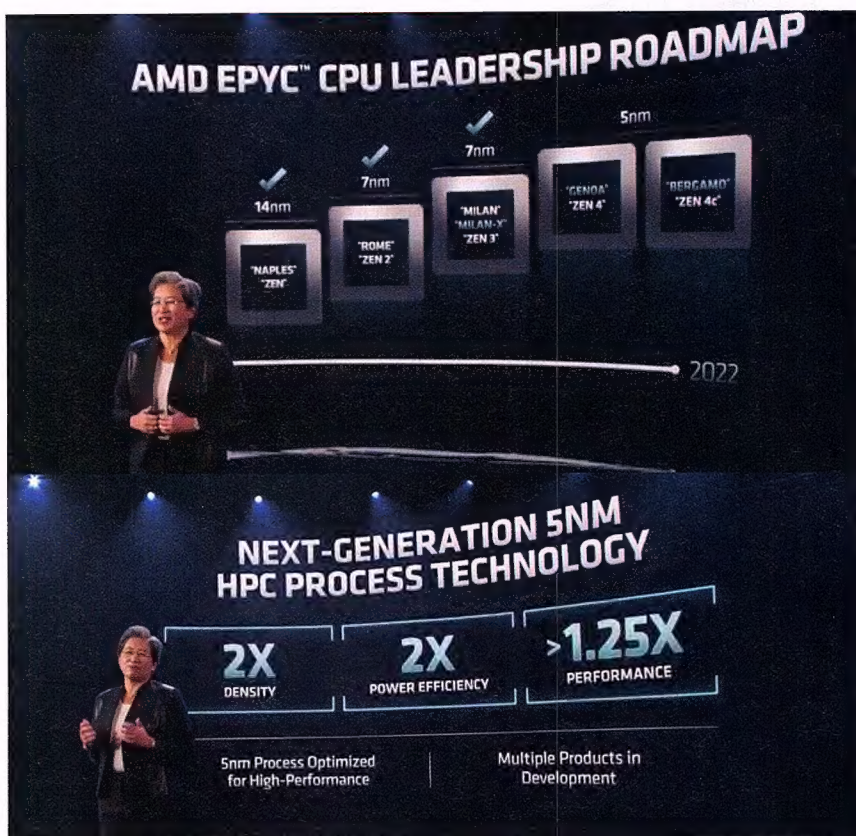


QUANTUM BREAKTHROUGH ALLOWS FULL SPIN QUBIT CONTROL

Key quantum obstacle conquered.

A research team with Denmark's University of Copenhagen has designed the world's first quantum computing system that allows for simultaneous operation of all its qubits without threatening quantum coherence. The research is being hailed as a breakthrough, clearing one of the remaining key obstacles for quantum scaling and its eventual mainstream deployment.

The Danish team achieved its breakthrough in one particular type of qubit, spin qubits. "To get more powerful quantum processors, we have to not only increase the number of qubits, but also the number of simultaneous operations, which is exactly what we did," states Professor Kuemmeth, who directed the research. The team is now looking to AI control systems that could automatically keep the system tuned with no human intervention.



CHIP NEWS

AMD unveils Zen 4 CPU roadmap

AMD drops the 128-core bomb.

AMD CEO Lisa Su shared the company's Zen 4 CPU roadmap at its AMD Accelerated Data Center event in November, including a 96-core Genoa model and a 128-core Bergamo chip. This adds yet more excitement to the event after AMD unveiled the EPYC Milan-X chips with up to 768MB of L3 cache and the Instinct MI250X GPU. AMD also shared its first details of the 5nm TSMC process it will use for the new Genoa and Bergamo chips, claiming it provides twice the density and power efficiency along with 1.25X more performance than the 7nm process AMD uses for its current-gen CPUs.

The new roadmap covers the fourth-gen EPYC processors. The 96-core Genoa will come on the 5nm process in 2022, while the 128-core Bergamo, also on 5nm, will come to market in 2023. In addition, Bergamo comes with a new type of 'Zen 4c' core optimised for specific use cases, meaning that AMD's Zen 4 chips will come with two types of cores, with the 'c' cores obviously being the smaller variants.

Here's AMD's TLDR for the Zen 4 CPU roadmap:

- "Genoa" will have up to 96 high-performance "Zen 4" cores, implement the next generation of memory and I/O technologies in DDR5 and PCIe Gen 5 and drive platform capabilities that perfectly balance the Zen 4 core, memory, and I/O to deliver leadership performance
- "Bergamo" is a high-core count compute engine, customised for cloud native applications that demand high thread density. Featuring 128 high performance "Zen 4 C" cores
- "Bergamo" has all the same features as Genoa including, DDR5, PCIe 5, CXL 1.1, same RAS, and the full suite of Infinity Guard security features, and it is socket compatible with Genoa

Genoa will have the 5nm process from TSMC, and AMD says 5nm offers twice the density and power efficiency of the 7nm process that powers the current-gen EPYC Milan chips. It also offers 1.25X of the performance of the 7nm process. That also bodes well for the consumer-focused Ryzen Zen 4 chips as well. Genoa is sampling to customers now and is on track for launch in 2022.



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techradar.com



Intel may be readying up to 32 Arc models

Happy GPU family incoming?

According to a new driver release, Intel may be prepping as many as 32 Arc Alchemist discrete GPU models for desktops and laptops. The number may indicate that Intel will offer a rather broad family of standalone GPU offerings aimed at various applications.

Intel's graphics drivers v30.0.101.1002 for integrated and standalone GPUs indicate that Intel has reserved as many as 32 PCI IDs for its DG2 family of discrete graphics processing units set to be marketed under the Arc Alchemist brand, *LaptopVideo2Go* revealed (via *VideoCardz*). A PCI ID typically represents

a separate product or a SKU (stock keeping unit).

Intel's official artwork for its Arc Alchemist family of discrete GPU only depicts two processors. This could mean Intel plans to release two graphics chips (a big and a small one) and offer them in different configurations (or it may mean Intel's designers decided to show two chips without any meaning). Making 32 distinct products using two graphics processors may not be common, but it's possible. At this point, it is unclear which GPU models are aimed solely at notebooks and which can be used both for desktops and laptops.

Apple reportedly readies 3nm Mac SoCs

Rumoured to launch in 2023.

Apple's aggressive Mac system-on-chips (SoCs) development plan reportedly now includes three 3nm chips – codenamed Ibiza, Lobos, and Palma – that will arrive in 2023 and will offer up to 40 general-purpose CPU cores.

With its M1-series SoCs, Apple has managed to build quite a formidable family of highly-integrated processors that can compete against the vast majority of the best CPUs from AMD and Intel. The only processors that are

untouchable for Apple's M1 Max are high-end desktop/workstation offerings like AMD's Ryzen Threadripper and Intel's Xeon W. But Apple now supposedly has a hard-hitting SoC roadmap that includes a 40-core CPU due to be released in about two years from now.

Next year it is believed that Apple plans to introduce its 2nd generation M-series SoCs using an enhanced version of TSMC's N5 node (M2-series?).



STEAM DECK DELAYED TO FEBRUARY 2022

Due to global supply chain issues.

Valve has notified customers that it is delaying the Steam Deck for two months, pushing it to February 2022.

"We're sorry about this," Valve wrote in emails to customers and on its blog. "We did our best to work around the global supply chain issues, but due to material shortages, components aren't reaching our manufacturing facilities in time for us to meet our initial launch dates."

The company said reservation updates would be updated soon. "All reservation holders will keep their place in line, with dates shifting back accordingly," Steam wrote in an emailed statement. Valve was rapidly approaching the December release date prior to this announcement, so it's unclear what further information the company may release between now and February.



TRUCKLOAD OF RTX 30-SERIES CARDS STOLEN

EVGA shipment lost to thieves.

In a world where graphics cards are used to play games, mine cryptocurrency, and do scientific calculations, their value gets very high. Consequently, when they are in short supply, their actual selling prices skyrocket, which naturally makes them a target for thieves.

A shipment of EVGA GeForce RTX 30-series graphics cards containing virtually the whole lineup starting from the GeForce RTX 3060 all the way to the GeForce RTX 3090, which are among the best graphics cards nowadays, was stolen from a truck in Southern California on October 29, 2021, the company said in a statement. It is unclear if an armed robbery took place, but a truckload of expensive graphics cards is certainly worth tens of thousands of dollars these days.

WEARABLES



5 reasons why I'm upgrading to the Apple Watch Series 7

It may not be the new design I expected but there's lots of reasons why I'm upgrading to the new Apple Watch Series 7



Nintendo Switch OLED gamers will be thrilled to discover this hidden upgrade

A Nintendo Switch OLED dock discovery points to something very, very exciting

BY ROBERT JONES • LAST UPDATED 5 DAYS AGO



Netflix's Squid Game is a battle royale version of the Saw films and I was not prepared for it

No wonder the South Korean series is set to become Netflix's most popular show to date

BY MATTHEW FORDE • LAST UPDATED 6 DAYS AGO



Video: this Smart Life golf challenge proves tech can improve my golf... but it can't work miracles, sadly

Who takes a rangefinder AND a GPS watch to a 9-hole golf challenge? T3 of course...

BY DAVID USHER • LAST UPDATED 8 DAYS AGO



Nintendo Switch OLED has a fantastic hidden upgrade



Cord vs Cordless Drills: what's best for your next DIY project?



Try these mini challenges for mental wellbeing, says brain scientist

Want more T3?

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TECH BRIEF

5D storage offers 10,000x Blu-ray density

Bringing sci-fi to mainstream one step at a time.

Researchers with the University of Southampton, UK, published research eerily reminiscent of the sci-fi concept of a “data cube” – promising incommensurate storage in a palm-sized device. However, that concept may be much closer to reality than expected, as the research describes a new, high-speed laser method of writing onto 5D structures. The 5D structure, built out of silica glass, can support long-term writings – and achieve storage densities that are 10,000x higher than current Blu-ray technology.

The new laser technology enabled the researchers to write in five dimensions – two optical and three spatial. The new approach can achieve write speeds of 1,000,000 voxels per second, the equivalent of 230 kilobytes of data (more than 100 pages of text) per second. That may sound ridiculously slow by today’s standards – just look at the speeds the best SSDs achieve in comparison, such as 5,000MB per second writes on the Samsung 980 Pro. However, some particular use-cases could benefit very much from such a technology, such as museums, libraries, and sure, the Ark-paradigm in science fiction. Furthermore, this technology actually could translate into real-world, cold-storage applications.

The team decided to test-drive their technology by writing 5GB of data onto a 5D, silica glass disk. The researchers then asked one of the essential questions regarding storage techniques – is the data you are writing stable enough that you can get it back from its written state? The answer was a 100 percent successful readout. However, the test was conducted in only a small portion of the available medium – if filled to the brim, the silica glass disc would be able to hold 500TB of data. The researchers say that with improvements to the writing techniques, particularly by taking advantage of parallelism, they can design a system that can fill that



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same 500TB in a mere 60 days. The picture is a nice one: imagine if 500TB of backup-only storage could be condensed onto a single external hard drive. That’s the density scale advantage of this medium, compared to the file servers one would need today.

How the data is recorded onto the medium is eerily reminiscent of *Blade Runner 2049*’s data spheres built from what appeared to be glass. Unfortunately, they also exhibited cracks that turned the medium unreadable. That would also seem to be the case on these particular silica glass data storage devices. The way of inscribing information is through extremely localised and precision-guided interactions between a

high-repetition femtosecond laser and the silica glass structure. Essentially, the technique involves conducting extremely controlled explosions inside the silica structure. These explosions are controlled for temperature due to the nature of the laser’s interaction with the silica glass and the resulting data structures (a nanolamella-like structure measuring just 500 by 50 nanometers each) can then be read back.

The team has already demonstrated that 5D data storage in silica glass could last basically forever. So long as we don’t let these glass storage devices fall – or crack, of course.

Francisco Pires ■

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END USER

NFTs are coming to games, but are they already here?

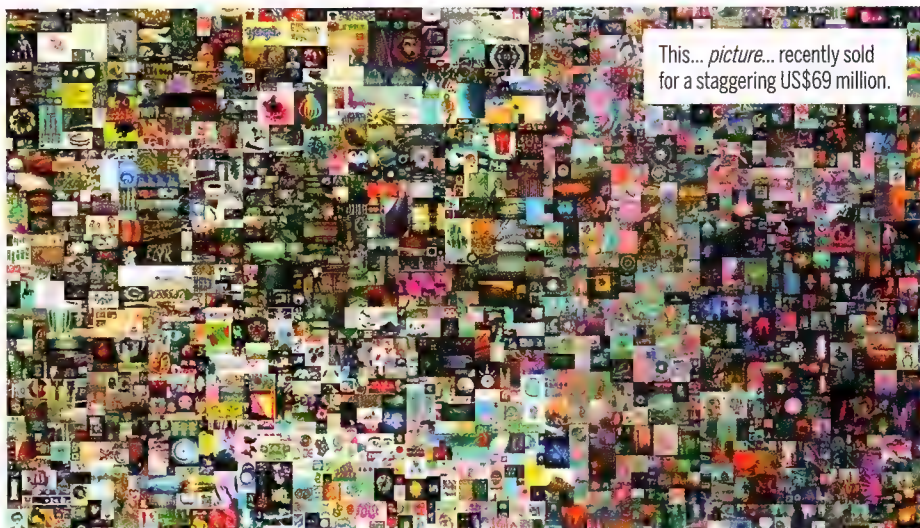
The industry is considering them, but gaming has had rare digital goods for a while, writes Shaun Prescott

In the ever-starkly polarised world of social media, NFTs – or non-fungible tokens – are either a brilliant way to apply value to digital goods with blockchain tech, or a scam-laden scourge that will destroy the world. It's still early days, but the truth seems somewhere in-between: the concept isn't inherently bad, though its reliance on energy-intensive cryptocurrency is a perfectly legitimate cause for concern.

Suffice it to say that NFTs are fairly controversial, but they cannot be ignored. NFTs have sold for millions of dollars, with digital artist Beeple (their real name is unknown) selling a work at auction for a mindblowing US\$69 million. But chances are you've heard about all this lunacy, which over the course of 2021 has morphed from a seemingly radical and underground concept into something that – inevitably – the gaming industry wants to get involved with.

The days of blockbuster-vendors publishers simply releasing a nine-hour game and moving onto the next one are very quickly dying: nowadays it's all about engagement, attracting daily log-ins, and of course, selling in-game items. Electronic Arts knows this: just look at *FIFA* and *Apex Legends*. So it's no surprise that EA CEO Andrew Wilson was among the first gaming industry executives to unambiguously embrace the prospect of NFT integration.

"I think that in the context of the games we create and the live services that we offer, collectible digital content is going to play a meaningful part in our future," Wilson said on the topic of NFTs and "play-to-earn" formats. "So, it's still early



This... picture... recently sold for a staggering US\$69 million.

to tell, but I think we're in a really good position, and we should expect us to kind of think more innovatively and creatively about that on a go-forward basis." Meanwhile, horror game *Dead By Daylight* has already started licensing its in-game models to NFT creators.

It's not all sunshine and daisies though: Valve has banned all NFT and cryptocurrency based games from Steam, probably because it's too much of a hassle to police them (of course, arch-contrarian Tim Sweeney, Epic Games CEO, announced his storefront would welcome these games after Valve's decision). Ever-rational Take-Two CEO Strauss Zelnick says that he believes in collectible digital goods, but doesn't believe NFTs are necessarily the answer. "Blockchain authorisation, which is what an NFT really is, is one way – not the only way – to authenticate the fact something is singular, is rare." He's right too: *Counter-Strike* didn't need the blockchain to generate digital weapon skins that can sell



SHAUN PRESCOTT
Author, *PC Gamer*
editor and passionate
technology observer.
Shaun covers trending
tech topics for APC.

for thousands of dollars on auction.

But it's probably a matter of not if, but when, blockchain-driven digital commodities start appearing as rewards or premium purchasable in mainstream games – even if they're given a different, more palatable name than the polarising "NFT". Their environmental impact dovetails with the impact already borne of Ethereum-mining emissions, so that point of criticism must also take issue with cryptocurrency as a whole. If "proof of work" (aka, mining) is left behind for the "proof of stake" model (ie, reserving cryptocurrency tokens in order to prove a stake) there is no reason why NFTs as a concept can't be adopted. Ethereum plans to move to a PoS model in 2022.

So if NFTs ever lose their environment-destroying stigma (which is totally possible) they'll basically become a blockchain-operated alternative to a digital goods market that has already existed in the gaming industry for years. Whatever the case, if you believe an NFT-driven collectible economy is going to ruin games, I've got news for you: you're already living in it by another name. ■

It's not all sunshine and daisies though: Valve has banned all NFT and cryptocurrency based games from Steam, probably because it's too much of a hassle to police them.

Web3, NFTs and the future of gaming?

Web3 is designing a new internet that is an online community beta, allowing you to trade valuable in-game items on an open decentralised stock market.

If you believe Mark Zuckerberg's roadmap then the 'successor to the mobile internet' will be an AR metaverse, built and operated by major corporations to feed even more advertising to people – but for those that prefer to keep their finger on the pulse of the future through the annals of Discord chat rooms, then the future of the internet looks like it could be a much more grassroots enterprise.

While the first iteration of the internet allowed people to create static web pages that could be read like books and Web 2.0 made those pages accessible, interactive and easy to manipulate, the third iteration of the internet is very much still being decided. One vision for it comes in the form of Web3, a blockchain-based, decentralised internet that has the capacity to integrate cryptocurrency and smart contracts directly into the platform.

The first major drawback of Web3 is that, like many other blockchain-based enterprises, it's decentralised, so it's running on a web of people's computers rather than being pumped from a Google server. The next element in the equation is that 'trust' is baked into the system through the blockchain, so you don't need to sign in to accounts verified by third parties in order to use the system securely. All you need is a blockchain wallet address and the password, and you can do whatever you can afford to do anywhere on the platform.

While the simple transactional element of Web3 is pretty easy to comprehend, the real value-add of this kind of structure emerged following the recent boom in non-fungible tokens (NFTs). If you aren't aware of the success of Bepple, CryptoPunk or EtherRock in 2021, then NFTs are simply blockchain-based proofs that certify the ownership and transactions of digital artworks. Shaun also touched on this topic in his column this month (p16).



JOEL BURGESS

When not reviewing PCs for *APC* and writing our funny pages, Joel likes to ponder tech and how it's used.



While the popularity of the NFT has increased exponentially over the last year, they have a raft of applications in Web3 that go beyond the art world, including; making persistent objects barterable and tradable, or as individual identifiers that facilitate community shareholder contracts.

Reddit is currently developing a Web3 platform to turn its community karma points into tokens that can be automatically delivered to community members according to smart contracts, and would allow proportionate shareholder voting on important decisions. But smaller indie games like bibliothecaforloot.com are experimenting with new game models that are owned and built by communities of players called Decentralised Autonomous Organisations (DAOs).

In addition to the most active players getting a bigger say in the game's ongoing development, these text-based RPGs are building their own token economies on the blockchain in a way that interfaces directly with Ethereum and can easily translate into tangible currencies. This means that these Web3 games are creating completely decentralised marketplaces for skins or in-game items that can be traded freely within games and even be exchanged for value that transcends different games.

Web3 is also currently exploring the possibilities of different kinds of professional gaming where smart contracts pay the winner or enough in-game resource collection could translate into real-world income after being bartered on the blockchain markets. ■

The first major drawback of Web3 is that, like many other blockchain based enterprises, it's decentralised, so it's running on a web of people's computers rather than being pumped from a Google server.





TWO BITS

The beginning of the end of GPU mining?

We await the ETH difficulty bomb.

In pretty much every GPU review written over the last couple of years, there's talk about inflated pricing, scarce availability and mining demand. Miners are willing to buy GPUs at prices well above RRP because they pay for themselves over time; such are the rewards for mining Ethereum. But, there's something on the horizon that will reset the GPU market. It's referred to as the ETH difficulty bomb, and as we move closer to its currently scheduled mid-2022 release, market availability of GPUs is set to improve.

Ethereum 2.0 is a big deal for crypto markets as a whole. Part of this change involves switching to Proof-of-stake – an alternative method of securing the network that eliminates energy intensive GPU mining. Before that switch, the Ethereum developers plan to significantly reduce mining rewards so that it becomes less attractive and eventually pointless to mine, therefore encouraging rapid adoption of the new PoS chain. This is the difficulty bomb we talked about. It's been delayed many times already, but the signs are that the shift should actually



CHRIS SZEWCZYK
A life-long PC tech enthusiast, Chris has worked across the industry in many areas as a product and technology expert.

happen this time.

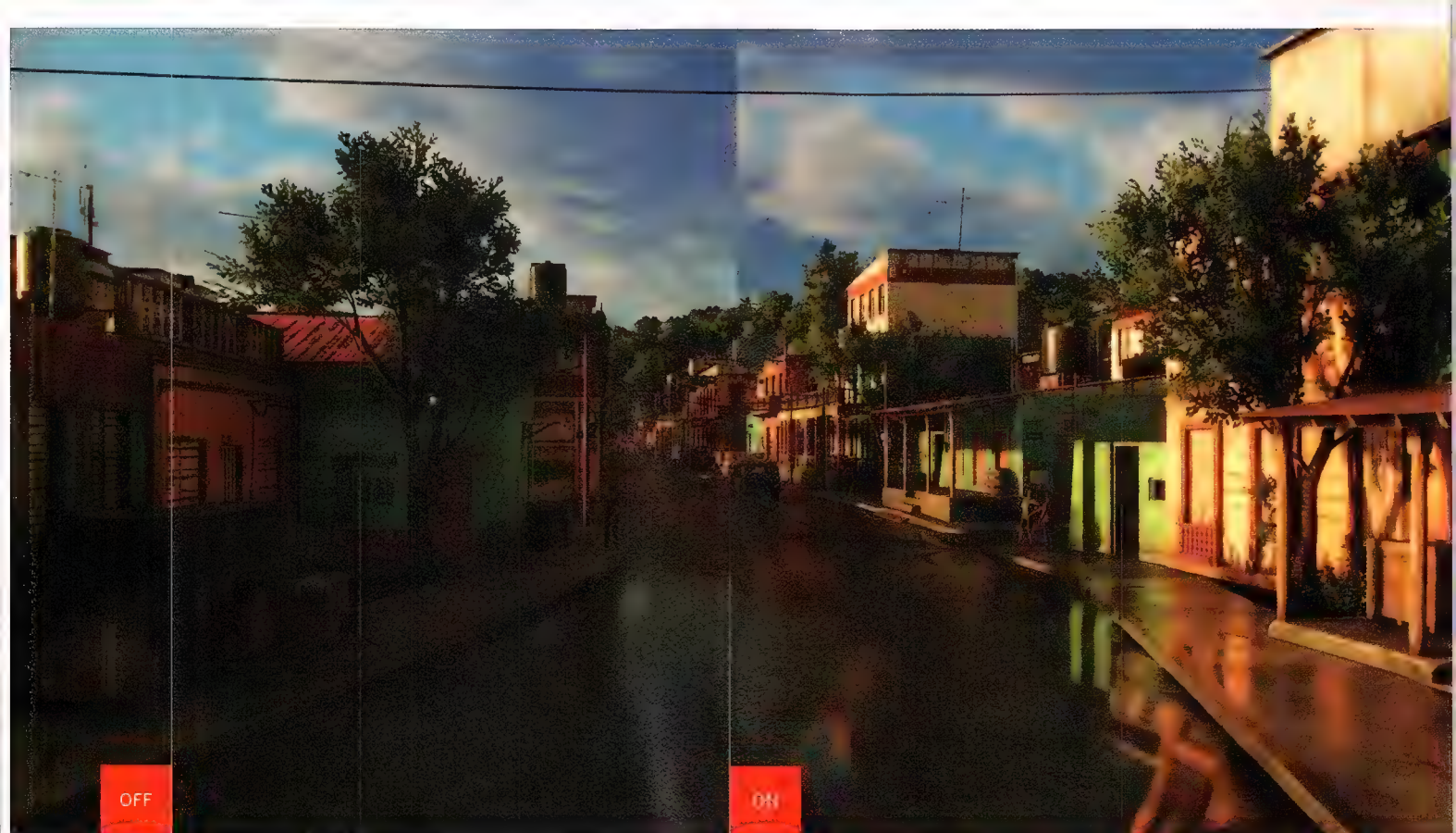
Mid-2022 is some time away, so why should GPU availability improve from now on? Miners know that at some stage their rewards will drop off, making it more difficult to recoup their GPU buys. This means less demand for new GPUs, more cards on shelves and more GPUs in the hands of gamers.

Assuming the bomb is introduced in mid-2022, miners have about eight or nine months to recoup enough to pay off new GPU purchases. As the release of the bomb draws nearer, new miner purchases should slow to a trickle. Would you drop thousands on new GPUs with the expectation that you'll mine with them for just a few months? Furthermore, as mining rewards start to decrease, miners will increasingly dump popular cards like the RTX 3060 Ti and RTX 3070 on sites like eBay, and they'll do so sooner while they can still sell them for stratospheric prices. Eventually supply will begin to outstrip mining demand. A trickle will become a flood. We'll see ads not for single GPUs, but ads for lots of a dozen or more. and

even more when the PoS switch date is confirmed. Would you risk buying a GPU that's been running 24/7 for months though? It depends on the market price. If you could grab a \$300 3060 Ti, many surely would.

How will GPUs makers react? Mid 2022 will be a good time to release new generation GPUs. RTX 40 and Radeon 7000 series cards should end up in the rigs of gamers, and not those of miners. How will they be priced? The market dynamic should be very interesting indeed.

Of course, there are other coins that can be mined even after Ethereum moves to PoS, but none generate returns as high as those of the Ethereum network, with its huge transaction fees and current price, and coins that come close don't have liquidity anywhere near the level of Ethereum to influence GPU demand on the scale we've seen. Time will tell if this prediction ages well, but the signs point towards the beginning of the end of large-scale GPU mining. Gamers and environmentalists have something to look forward to. ■



TECH TALK

RTX off

Far Cry 6 skips ray tracing on consoles.

Far Cry 6 is the first game in the long-running series to support DirectX Raytracing (DXR) and it is out on all the major platforms. Except, the ray-tracing effects will only be available on PCs – the PlayStation 5 and the Xbox Series X and S apparently aren't powerful enough to handle the extra work.

Either that or Ubisoft felt it was more important to hit higher framerates on consoles and that the ray-tracing effects didn't warrant the performance hit. It's another slap in the face for fans of ray tracing, but not without reason. Testing the game with and without ray tracing, the visual gains are more subtle than you'd expect from the drop in performance. However, I'm not convinced that the consoles couldn't have handled the RT workload. Case in point: the RX 6600 XT only has 32 CUs and ray accelerators, with a 128-bit memory interface. That's slower than any of the latest generation consoles, except for the Xbox Series S with 20 CUs/RAs. The performance at higher resolutions with ray tracing

enabled on the RX 6600 XT isn't that bad. At 1080p ultra, it managed 100fps without DXR and 67fps with DXR. That's imminently playable. Even at 1440p ultra with DXR, it averaged 52fps. 4K was a different matter – performance was 38fps without DXR and it tanked to 8fps with DXR. Oops!

The PC version also supports AMD's FidelityFX Super Resolution. The ultra quality mode does 1.3x upscaling in each dimension, so 4K with ultra quality FSR renders at 2954x1662. That's more demanding than 1440p, but performance is 42fps. If you move to higher scaling factors, you can get 50fps by using quality mode, 55fps with balanced mode, and 62fps with performance mode.

The PS5 and Xbox Series X should be a step up in performance from the RX 6600 XT – so imagine our surprise that *Far Cry 6* also omits FSR support on the consoles.

It's not just *Far Cry 6* and Ubisoft, though. The first major game with RT support was *Battlefield 5*, launching not too long after Nvidia



JARRED WALTON
Jarred Walton has been a PC and gaming enthusiast for over 30 years.

unveiled the RTX 20-series GPUs. It used RT for reflections and, as an action shooter, maybe it wasn't the best place for improved visuals at the cost of lower framerates. EA has decided to skip RT on the upcoming *Battlefield 2042*, and when you look at the games that use ray tracing, it's not hard to see why that is.

At present, research suggests less than a quarter of all gaming PCs have a ray-tracing capable GPU, and over half of those are the RTX 2060 – the slowest of all the ray tracing cards so far. Looking at the image quality improvements from RT in many games only makes the performance hit look less acceptable. We're well into the second generation of RT hardware from Nvidia, and it still feels like it will be a long slog to get more people and developers to embrace the technology. We can at least partly blame the consoles.

The PS5 and Xbox Series X are roughly at the performance level of AMD's RX 6700 XT and RX 6800, respectively. Those GPUs aren't slow, but they're only about as fast as the RTX 2070 and RTX 2080 when it comes to ray tracing. They should be fine for 1080p with RT effects, but with many TVs now running at 4K, we'll need a serious upgrade to the console hardware before RT can begin to go mainstream. ■

Ubisoft felt it was more important to hit higher framerates on consoles and that the ray-tracing effects didn't warrant the performance hit. It's another slap in the face for fans of ray tracing, but not without reason.



HOW IT'S DONE

TAKING THINGS APART AND HAVING A POKE AROUND

Samsung Galaxy Watch4 & Watch4 Classic

What makes it tick.

Samsung recently unveiled two updates to its smartwatch line in the Galaxy Watch4 and Galaxy Watch4 Classic. Though externally similar to last year's Watch3, there's a good chance of internal differences, and we're here to sniff them out. Time for a teardown!

Major tech specs

- Exynos W920 1.18GHz with dual ARM Cortex-A55 cores, Cortex-M55 display processor, Mali-G68 GPU, and integrated LTE
- Circular Super AMOLED always-on display – 1.19-inch or 1.36-inch sizes (both models) 330 PPI
- 1.5GB RAM and 16GB internal memory
- 361 mAh battery, Watch4 Classic (46 mm). 247 mAh battery, Watch4 (40 mm)
- Sensors, including accelerometer, barometer, gyro, geomagnetic, light, optical heart rate, ECG, bioelectrical impedance sensor, and a Hall sensor on the Classic
- IP68 rating with water resistance to a depth of 50m (5 ATM)

Key findings

Though the Galaxy Watch4 and the Galaxy Watch4 Classic have almost identical specs, they each rock their own look. The Watch4 Classic is bulkier but has some classy stainless steel or titanium frame options. Both models open up through the back: a specialty driver easily takes care of the four tri-point screws and a quick pry from an opening tool

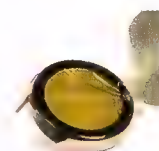
gets us inside.

What we find is: a Samsung package combining the Exynos W920 dual-core 1.18GHz processor with 1.5GB of its in-house LPDDR4, Samsung Shannon 915 intermediate frequency IC, Broadcom BCM43013 ultra low power dual-band 802.11n Wi-Fi and Bluetooth 5.0 combo IC, and likely a Qualcomm Atheros QPA5580 power amplifier. The back of the Watch4 (not the Classic) shows us a couple more of those same chips: S915 intermediate frequency IC and a Broadcom BCM43013 ultra low power dual-band 802.11n Wi-Fi and Bluetooth 5.0 combo IC.

The fuel tanks are hidden under the motherboards, nestled within plastic midframes, and can be removed with the help of a sturdy spudger. The Watch4 Classic accommodates a 1.40Wh (361mAh @ 3.88 V) battery, while the Watch4 houses a 0.95Wh (247mAh @ 3.88 V) battery.

We shake the last components out of the midframe and find a familiar vibration motor next to the barometric sensor. The most interesting part is the button flex cable. It not only carries a microphone but is also equipped with a contact plate opposite its connector. This allows the watch to close an electrical circuit through your body for bioelectric impedance analysis.

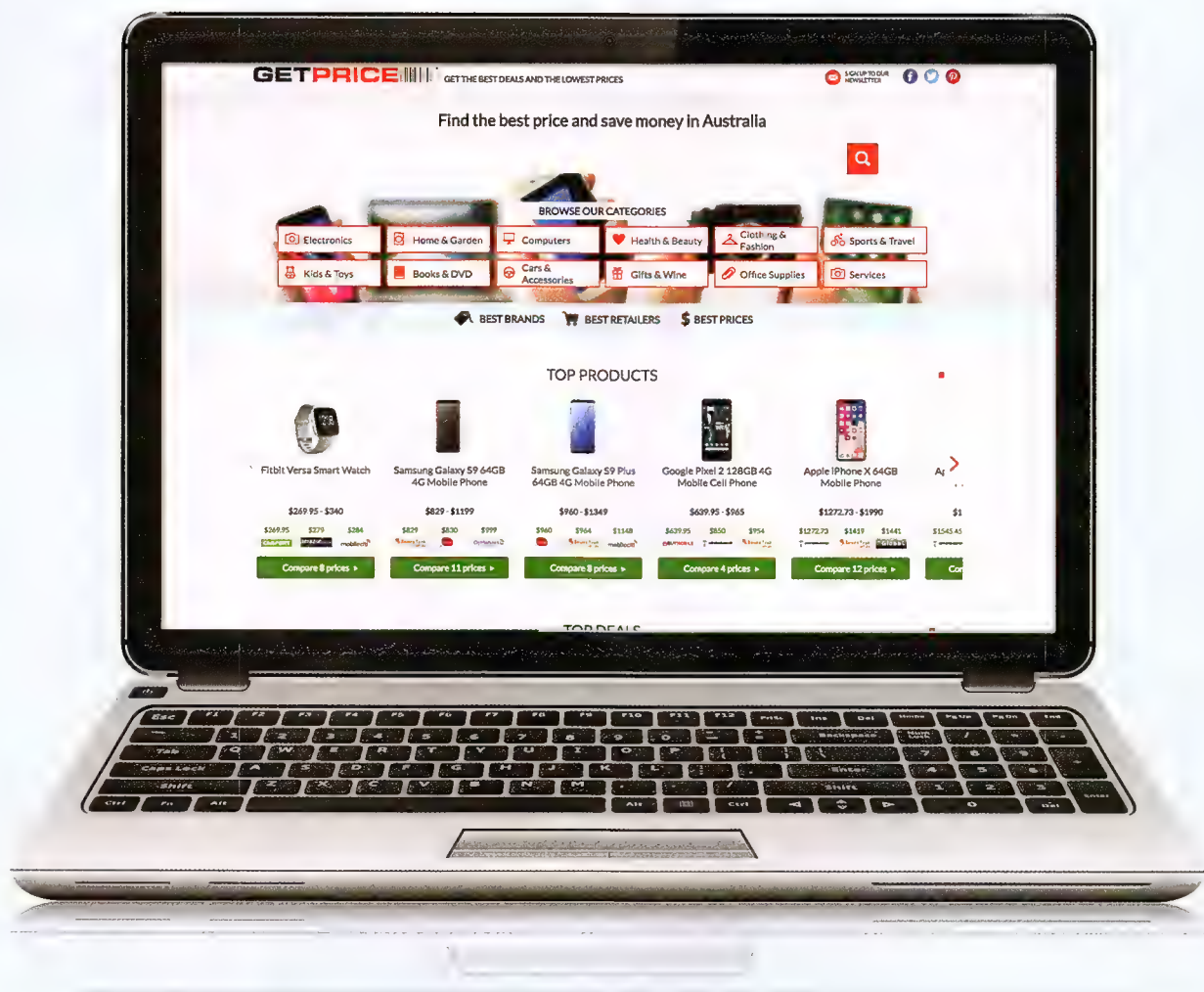
The Watch4 Classic prioritises simple display removal. With a little heating, we separate the circular AMOLED screen from the frame



A toasted-yellow cracked AMOLED display is the result of attempting to remove the Watch4's screen.

Both the standard and Classic Watch4 models ditch the previous round buttons, seen on the Watch3, for sleek rectangular buttons.





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GADGETS

NICE LITTLE THINGS

US\$19 | tinycircuits.com

Thumby

A mini keychain-connected GameBoy that you can program yourself.

Imagine being out and about and both your phone and your smartwatch and all your battery banks have run out of power. There's not even a powerpoint nearby that you can charge your devices with and you left your Nintendo Switch at home. What are you going to do till you can get back to alternating current? Thankfully the creators of a new Kickstarter know exactly how to solve this conundrum: a keychain connected mini GameBoy called Thumby. Other than the five included retro games, you're going to have to build your own fun using MicroPython code, but if you're good enough at the coding, you'll never have to be alone with just your thoughts ever again.



\$150 | satechi.net

SATECHI STAND & HUB FOR MAC MINI WITH SSD ENCLOSURE

A Mini with more.

For those with the latest M1-laden Mac Mini desktops from Apple, the lack of front-facing ports (and dearth of ports more generally) can be solved with this bit of kit from Satechi. Specifically designed to sit beneath your

Mac Mini, this dock adds three more USB-A ports, microSD and SD card readers, and an extra 3.5mm port, all the while blending seamlessly with Apple's original design. There's also a USB-C port to replace the one it occupies by connecting to your Mac Mini, and an SSD enclosure on the underside of the unit, compatible with M.2 SATA drives to help expand your unit's storage.



\$199 bonelk.com

BONELK 14IN1 MULTIPORT DESKTOP HUB

Almost everything-in-one.

It's always tricky to find a hub that has the ports you need, and it's usually a matter of either compromise, or over-spending and getting more than you actually want. For many, us included, the new Bonelk 14-in-1 is a damn fine solution. With 3x USB 2, 3x USB 3 and a USB-C – it's enough for most things to connect. A gigabit ethernet port is here and SD plus micro SD slots are included, and most handily a pair of HDMI ports. Because the latter limits screen res to 30Hz @4K we'd love to have seen DisplayPort included, but that's our only want in this almost-perfect desktop problem solver.



\$128 yubico.com

YubiKey Bio

Now with fingerprint scanning.

We've long been impressed by YubiKey products for securing our devices. With industry-leading authentication standards including passwordless logins and 2FA, they're portable and pocketable keys for your devices. The new Bio series adds a fingerprint scanner that can combine the biometric scanner with passwordless MFA for tighter login security. A backup PIN can be added if you need it, too. It's available in both USB-C and USB-A form factors.



US\$999 (\$599+\$400 Ninebot S)
store.segway.com/ninebot-mecha-kit.

SEGWAY NINEBOT MECHA KIT

A great 'family bonding experience' for Silicon Valley execs to buy for their kids.

If your kid already got a Ninebot S last Christmas and it would be just gathering dust if your team of housekeepers didn't clean their waterfront bedroom every day, then it's time to double down and buy the US\$599 Ninebot Mecha Kit. This amazing system will connect with any of the US\$400+ Ninebot S range to give it a seat, joystick and a set of water absorbing BB bullets that you can shoot at the neighbour's cat. Hell, you may as well just buy a handful for friends and family so you can shoot the crap out of each other and achieve the "New Family Bonding Experience" the marketing material promises.



\$115 | satechi.net

SATECHI SLIM USB-C MULTIPORT ADAPTER (V2)

A little evolution.

The second version of Satechi's Slim MultiPort adapter hasn't changed too much, but it hasn't really needed to. One of the most popular products from the peripherals brand, this adapter converts one of your device's USB-C ports into a wealth of connectivity (especially handy for MacBook Pros that have USB-C outputs exclusively). It boasts one USB-C and two USB-A ports, a HDMI output, and micro SD and SD card readers, which have been upgraded with a reassuring 'click' when inserting your card. Other upgrades include a refined design and support for 4K resolution at 60Hz over HDMI, up from the 30Hz of its predecessor.



The versatile new MateBook family

MEET HUAWEI'S ULTRAPORTABLE LINEUP

HUAWEI is launching its latest laptops: the ultraportable MateBook family. These laptops deserve to be on anyone's Christmas wish-list this year, as they offer that rare combination of productivity-boosting performance and ergonomics that make them a joy to use. Whether you need a laptop for school or the boardroom, HUAWEI has you covered with models ranging from the \$1,199 MateBook D 14, through to the \$1,799 MateBook 14, to the eliteMateBook X Pro.

What's great about the new HUAWEI MateBooks?

All three of the new HUAWEI MateBooks have characteristics that are consistent across the range. All have ultra-slim, sturdy, lightweight, sub-1.5KG, metal

chassis that have been sandblasted and diamond-milled. Their 'Slate Gray' styling oozes sophistication in a way that they'll turn the heads of passers-by and attract approving nods in the boardroom.

All sport screens with TÜV Rheinland's 'Low Blue Light' and Flicker Free certifications to ensure that they're comfortable to look at for extended periods.

They all make use of the HUAWEI's powerful, phone-derived, rapid-charger technology which means the charger is pocket-sized and can also be used on phones and tablets (so there's even less to lug around)! They're quick, too. Just 15-30 minutes of charging will allow you to work for hours.

All have fingerprint readers embedded

into the power button. On the top models, these are linked to TPM modules for hardware-based encryption and compatibility with Windows 11 (you can upgrade for free).

HD webcams are cleverly recessed inside the keyboard for privacy and ensure that bezels surrounding the screen are as thin as possible. Web conferencing is enhanced by new, front-facing, dual-array microphones which can detect voices from five metres away while simultaneously using special algorithms to block out background noise.

If you have a HUAWEI phone you can also make use of the fantastic HUAWEI Share app. This allows you to share and edit files on your phone and computer like they were a single device. You can drag and drop files between them, use the phone as a second screen and connect just by tapping the MateBook's NFC sensor. A new 'Collaboration' update lets you display and interact with multiple phone apps on your desktop, amongst many other things.

HUAWEI MateBook X Pro

HUAWEI's new 13.9-inch flagship weighs just 1.33KG, is less-than 15mm thick and yet contains an 11-hour battery that can be rapidly charged for four-hours work in just 30 minutes.

Opening up the MateBook X Pro reveals the resplendent screen. It sports an improved 3:2 aspect ratio which offers additional screen real-estate to enhance media and help make you more productive. The bright (450-nit), UHD 3K resolution renders everything in sharp relief – whether you're staring at spreadsheets or graphics. Its ability to display 100 per cent of the sRGB colour gamut means you know that the colours are accurate.

Amazingly, it also supports 10-point touchscreen interactivity which has



All of the new HUAWEI MateBooks combine beautiful styling with power, performance and innovative features, all ready to power you through the day.



- 1 Power up your new Huawei MateBook today.
- 2 Biometric security is included, with a fingerprint scanner built into the power button.
- 3 HUAWEI's Free Touch technology means a smooth and responsive trackpad.
- 4 The integrated web cam.



previously been something a battery-vampire for laptops. What's more, it does so while repelling fingerprints(!) This feature also has some enhanced functionality – you can take a screenshot just by swiping with three fingers. The whole effect is enhanced by a super-thin, barely-there, 'FullView' bezel which surrounds the screen.

Interacting with the MateBook X Pro is a joy, too. The back-lit Chiclet keyboard enables fast, accurate and comfortable typing while the trackpad has been re-engineered with new, 'Free Touch' technology to allow smoother and more-accurate multi-touch activity.

A quad speaker array provides immersive audio that you wouldn't expect from such a thin device.

Performance of the HUAWEI MateBook X Pro

Inside there's one of the latest, 11th-Gen. Intel Core i7 processors, 16GB of special low-power 4,266MHz LPDDR4x RAM and 1TB of fast, NVMe storage. The integrated Intel Iris Xe graphics will even be able to play casual and competitive games. It all combines to provide 22 per cent faster performance than the previous generation.

There's the latest, Wi-Fi 6 and

BlueTooth 5.1 wireless connectivity. Plus, the latest wired connections are catered for: two USB-C 3.2 Gen. 2 ports provide a whopping 40Gbps transfer speed (that can support two, 4K monitors). There's also a USB-A 3.2 Gen.1 port and a 3.5mm audio jack.

If you're worried how powerful components will operate in such a thin chassis, rest assured that the new "Dual-fan Cooling System", with its Shark Fin fan design and ultra-slim heat-dissipating, vapour-chamber modules, keeps everything running in a cool and stable manner.

The MateBook X Pro costs \$2,999. Buyers who order early can even get bonus a set of HUAWEI FreeBuds Pro wireless earbuds worth \$329!

HUAWEI MateBook 14

If you don't need all the bells and whistles, check out the \$1,799 HUAWEI MateBook 14. This beauty is just 15.9mm, weighs only 1.49KG and has an 11-hour battery life. It has a 3:2, IPS screen with a crisp, UHD, 2,160 x 1,440 resolution that also supports 100 per cent sRGB.

Inside is an Intel Core i5-1135G7 processor and a 512GB NVMe SSD. It has Wi-Fi 6, BlueTooth 5.1 and a complement of the latest, wired, connectivity ports.

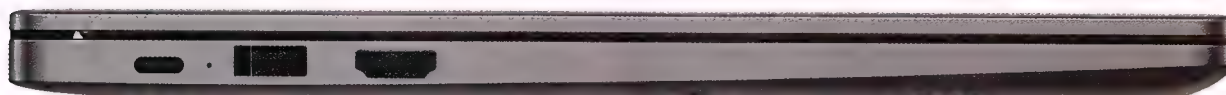
Early buyers can also get free HUAWEI FreeBuds Pro (while stocks last).

HUAWEI MateBook D 14

If budget is your prime concern, check out the \$1,199 MateBook D 14. This well-built ultraportable weighs just 1.38KG, is 15.9mm thick and has a 13-hour battery life. The colourful, 14-inch IPS screen has a Full HD resolution and the bezels surrounding it measure less than 5mm. Inside, a 512GB NVMe drive and Core i5-10210U processor provide power-efficient performance. Connectivity includes Wi-Fi 5, Bluetooth 5.0, USB-A, USB-C, an HDMI 2.0 port and a 3.5mm audio jack. Sound comes from dual, 2-Watt speakers. Ultimately, the HUAWEI MateBook D 14 offers everything people want from a work-oriented ultraportable. Early buyers can get a free backpack worth \$99 (while stocks last).

Which MateBook should you buy?

With all three HUAWEI MateBooks offering stylish portability, you can make an easy choice of which device suits your power and performance requirements, and that that matches your budget. Whichever you choose, whether it's for yourself or someone else, these laptops will make someone very happy this Christmas.



DISCOVER YOUR MATEBOOK Find out more at consumer.huawei.com/au/laptops/matebook-x-pro-2021

THE LAB

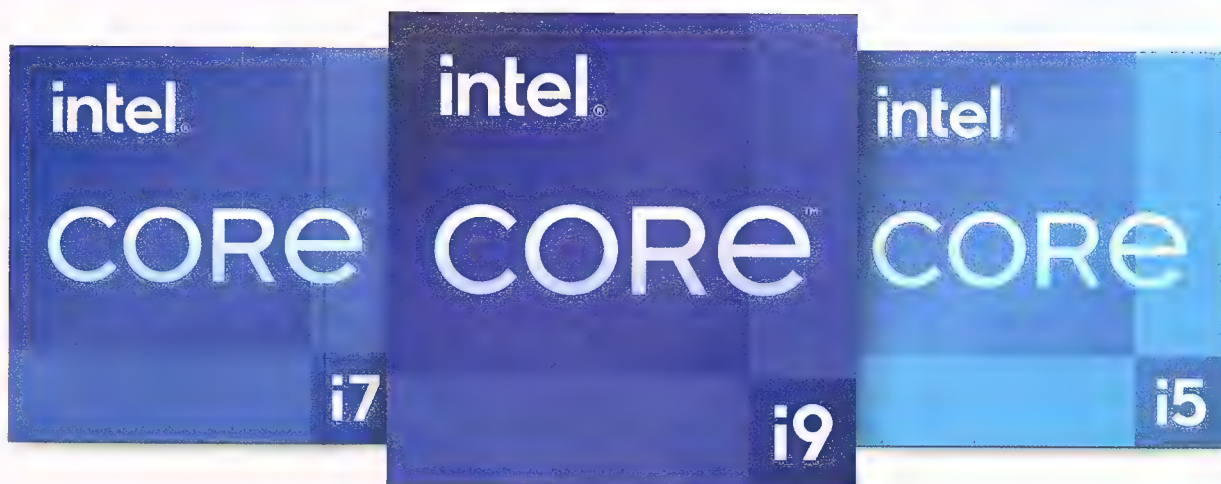
REVIEWS

THE HOTTEST GEAR LABS TESTED

Introducing Intel's 12th Generation CPUs

Intel's biggest architectural overhaul in a decade.

The Alder Lake die laid bare. Shown here is the i9-12900K.



The launch of an all new CPU architecture is always an exciting time for PC enthusiasts. Intel's 12th Generation CPU architecture, codenamed Alder Lake, is certainly the company's most important CPU architecture in the last decade. It represents a fundamental shift for Intel, and it lays the foundation and roadmap that Intel's desktop and mobile platforms will follow for many years to come.

AMD has had a great time with its highly competitive Ryzen offerings, achieving its highest market share since the heady days of the Athlon64 in 2006. Intel, for so long the totally dominant market leader, was no doubt stung. Alder Lake is Intel's attempt to wrest control of the narrative back. A hybrid architecture and the move to its 10nm Enhanced SuperFIN process (named Intel 7) has thrust Intel back into the spotlight after several generations that lacked genuine innovation. Is Alder Lake the giant leap we're hoping for?

The 12th Generation Core lineup

Intel has staggered the launch of its 12th Gen processors. The first to launch are the K models, the 16-core i9-12900K (8+8), the 12-core i7-12700K (8+4) and the 10-core i5-12600K (6+4). These are joined by KF models that lack integrated graphics. Following later are multiplier-locked, non-K versions and, of course, more i5 and i3 models in 2022.

12th Gen CPUs introduce DDR5 memory and PCI Express 5.0 support along with Z690 motherboards with a new LGA 1700 socket. The larger socket dimensions mean that LGA 1200 coolers won't fit without an LGA 1700 mounting kit. Fortunately, many cooling manufacturers plan to release updated mounting kits if they haven't already done so.

A look at Alder Lake

Let's begin with the hybrid architecture. What does it mean? Alder Lake includes two different types of cores. There are the Performance cores (P-cores) and the Efficient cores (E-cores). Their names indicate their purpose. The P-cores are codenamed 'Golden Cove'. Intel claims these cores offer a 19 percent performance

uplift over the Cypress Cove cores found in 11th Gen processors. They support hyperthreading and can more or less be considered traditional CPU cores. The energy efficient E-cores, code-named 'Gracemont', actually match Skylake's IPC, but at a fraction of the power consumption. These cores may prove to be the real star of the show, and should be particularly beneficial for mobile users. It's also interesting to note the different paths that Intel and AMD have chosen. Intel went down the hybrid path while AMD believes its chiplet and 3D stacking designs are the best path forward. Time will tell which approach works best.

There are many advantages that a hybrid design can offer. Energy efficiency and performance per watt would be foremost, but as we'll see, Intel threw that out the window in the case of the 12900K in an attempt to achieve maximum multi-threaded performance at any cost. However, with the right software awareness, the possibilities are very exciting. Let's take gaming as an example. You could have a situation where the P-cores can handle the game itself, leaving the E-cores to process background OS tasks and apps, or perhaps the P-cores handling physics and AI, while the E-cores handle audio processing. Hybrid architectures, perhaps with even further specialised sub-processors could change the direction of the future PC.

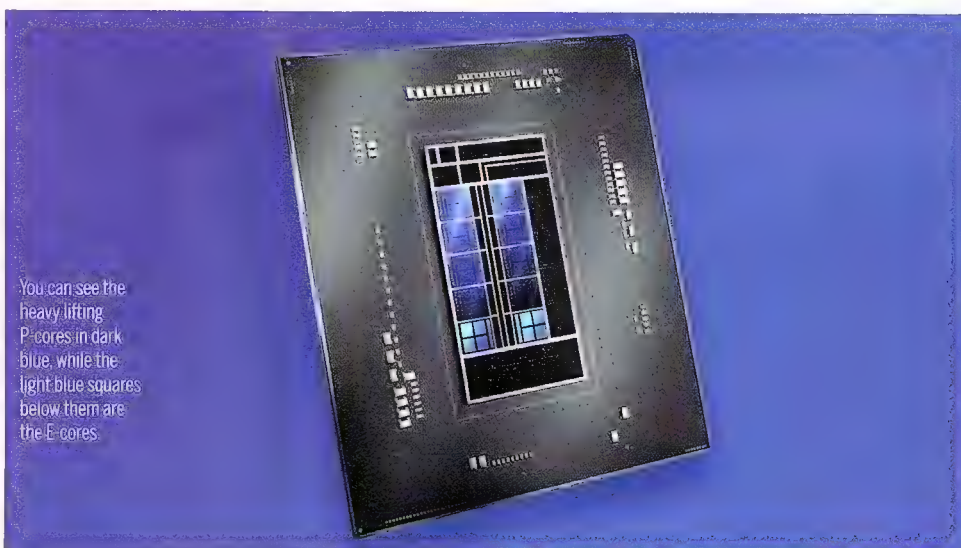
A CPU with two different types of cores requires software awareness. Luckily, Windows 11 is ready for 12th Gen CPUs. We're pleased that Intel didn't rely solely on software developers to do the heavy lifting. To alleviate potential software issues, Alder Lake includes a hardware-level thread scheduling controller called Thread Director. It functions as an interface between the core groups and the OS, helping the OS assign threads to the most appropriate cores at nanosecond intervals. It will be interesting to see how the ecosystem matures around the Thread Director and hybrid designs, even if most of it will happen away from the eyes of the user.

Apart from the hybrid P-core and E-core design, 12th Gen processors are built with Intel's 10nm Enhanced SuperFIN process. Intel calls this Intel 7. It finally lays to rest years of 14nm+++ memes. It can be considered roughly on par with TSMC's 7nm process in terms of transistor density. The 12900K die size is 215mm², smaller than Rocket Lake at 276mm². That's a significant saving, and that's with the eight E-cores added to the die too.

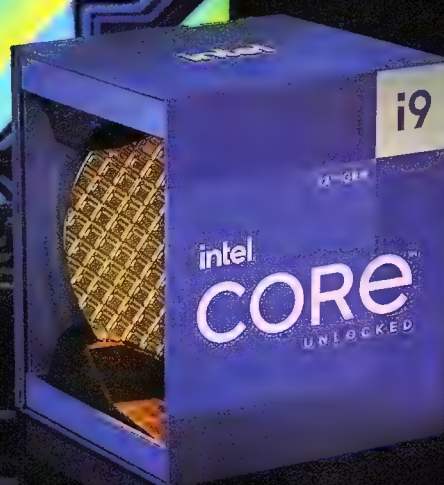
Well done Intel.

PCI Express 5.0 and DDR5 memory make their debut

12th Generation CPUs are the first to support PCI Express 5.0, meaning Intel has moved from PCIe 3.0 to 4.0 to 5.0 in under



We're always excited to see the latest innovations in retail CPU packaging – and 12th Gen is no disappointment.



a year. PCIe 5.0's usefulness won't become relevant for a while as there aren't any supporting devices, but it's the way of the future and PCIe 5.0 devices will be relevant for many years. The first devices we're likely to see are PCIe 5.0 NVMe SSDs. Several motherboard makers are introducing PCIe 5.0 M.2 add-in cards, so you'll be able to use drives that will be capable of sequential transfers of more than 14GB/s!

We can expect PCIe 5.0 GPUs in 2022, though PCIe 4.0 GPUs are hardly bandwidth limited. What's more likely is we'll see affordable GPUs with PCIe 5.0 8x connections. Even at x4, PCIe 5.0 offers the same bandwidth as a PCIe 3.0 x16 slot. Hardly sluggish.

Intel is the first company to adopt DDR5 memory. As is usually the case when a new memory standard is released, the first wave of kits struggle to offer good value for money. Of course, over the next few years that will change. Speeds will increase, latencies will improve and prices will drop. Remember, DDR4-2666 wasn't very attractive compared to the fast DDR3 of the time. Buying a DDR4 Z690 board is perfectly viable. You can re-use your existing memory, saving a good chunk of money in the process while giving away little, if any, performance. In the years to come we'll probably see DDR5-10,000 and lower latencies that see DDR5 push well ahead of DDR4.

We plan to dive deeper into DDR5 memory in one of our upcoming issues. Stay tuned for an in-depth analysis and reviews of a range of DDR5 kits that cover all budgets and use-cases.

Introducing the Z690 chipset

The first 12th Gen supporting chipset is unsurprisingly named Z690. It allows

overclocking of K SKUs and it will be followed by lower tier chipsets alongside budget CPUs in 2022. There are Z690 boards that support DDR5 or DDR4 memory, but not both at the same time. Z690 boards are superior to Z590 boards in many ways, though it appears they are a lot more expensive too.

Arguably the key feature of the Z690 chipset is the 8x DMI link between the chipset and CPU. This has been upgraded to support PCIe 4.0, which is double the bandwidth of Z590's PCIe 3.0 link. This means a board can accommodate more PCIe devices. Most boards include support for PCIe 3.0 and 4.0 M.2 drives, Wi-Fi 6 or

We really look forward to seeing what kind of impact Alder Lake will have on the mobile space. A well-tuned 25-45W class 12th Gen processor could bring a terrific level of performance without killing battery life.

6E, and faster or more USB connectivity. One of the big weaknesses of the mainstream platforms has been their platform I/O compared to HEDT chipsets. Z690 is a definite improvement in this area.

One clear trend we're seeing on Z690 motherboards is their very powerful VRM systems and large heatsinks, which were already considered very good on Z590 boards. They would not be there if they weren't needed, and it's clear, at least in the case of the 12900K, that they are. Interestingly, Intel has officially dropped AVX512 support, though the hardware is still present. Perhaps runaway AVX512 power consumption was simply too much to stomach.

We'll have a full guide and roundup of leading Z690 motherboards in our next issue. Stay tuned for that!

Closing thoughts

As usual, Intel K SKUs support overclocking. Though we didn't have a chance to overclock our samples thanks to severe courier delays, early indications are that the 12900K is right up against the wall already. Nevertheless, there are some interesting OC features, including E-Core overclocking, dynamic memory boosting with rewritable user profiles, and per-core hyperthreading enabling or disabling. One thing is clear. You'll need the best cooling you can afford if you want to OC an i7 or i9 to any meaningful degree.

We really look forward to seeing what kind of impact Alder Lake will have on the mobile space. A well-tuned 25-45W class, 12th Gen processor could bring a terrific level of performance without killing battery life. Intel states that Alder Lake is designed to be highly

scalable all the way down to ultra-portable TDP ranges.

As it stands, 12th Gen promises to shake up the market. A competitive Intel and AMD benefits everyone and we love to see both companies spurring each other on to bigger and better things. How will AMD react? Will we see Ryzen 5000 series price drops? We look forward to seeing how its V-cache enabled CPUs perform sometime in early 2022. For now, the spotlight is well and truly on Intel. To quote CEO Pat Gelsinger in a recent interview: "Intel is back".

Now that we've gone over the fundamentals of the 12th Gen architecture and covered some of the things to look out for, let's dive into reviews of the Core i5-12600K and Core i9-12900K. Believe the hype or not?

Read on!



\$499 | www.intel.com

Intel Core i5-12600K

It's a stunner.

The i9-12900K is the CPU that's tending to grab the headlines, but the real hero of the 12th Gen range may well be the Core i5-12600K. The 12600K contains six performance cores and four efficiency cores for a total of 16 threads. It definitely sits in the sweet spot for value and performance. Its high clocks should see it get close enough to the 12700K and 12900K, particularly with single threaded workloads and it should turn out to be a capable gaming CPU. And, it adds welcome power efficiency to the mix too.

As expected, you lose a little bit of boost clock vs the high-end CPUs but, interestingly, the base clocks of the 12600K are higher than those of the i9 and i7 CPUs. The six P-cores can boost up to 4.9 GHz while the four E-cores can boost to 3.6. The 12600K contains 20MB of L3 cache, and much like the 12900K, there's Intel UHD770 graphics and you have the choice of either DDR5 or DDR4 memory support, so by selecting a matching Z690 board, you can save a lot of money by sticking with your current DDR4 memory.

The 12600K offers a rather stunning level of performance for its price. It

Specifications

Intel Core i5-12600K; LGA 1700 socket; 6 P-Cores + 4 E-Cores, 16 threads; P-core Base/Max Clock Speed 3.7/4.9 GHz; Single E-core Base/Max Clock speed 2.8/3.6 GHz; 20MB Cache; 125W Base Power, 150W Maximum Turbo Power.

manages to beat out the 5800X in most cases, despite ostensibly being a six core CPU. The E-cores really do add a lot of performance. All other six core CPUs are left in the dust. The 12600K's single threaded and gaming performance elevates it ahead of everything except its higher priced 12th Gen siblings, though as we noted in our 12900K review, we feel there's room for improvement. Windows 11 and the x86 hybrid architecture are brand new, and with many years of software development to come, there could be some interesting performance surprises ahead.

The 12600K features a maximum turbo power limit of 150W, far below the 241W of the 12900K. With 16 threads at 150W, it's perfectly acceptable for a high-performance system. It's an example of how Intel CPUs are often unfairly labelled as power guzzlers. In our testing, the 12600K is only a few watts ahead of the 5800X while matching or beating it

in performance – sometimes by quite a lot. This means you don't need a high-end cooler and in fact even a decent mid-range cooler will be enough as long as you're not thrashing out heavy rendering loads all day.

The 12600K is the superstar of the 12th Generation range. It's a great example of how the Alder Lake architecture can be tuned for efficiency. Six P-cores and 12 threads plus another four E-cores for 16 threads in total is bang on the sweet spot for most users, including gamers. And with that, the 12600K becomes our new favourite mainstream CPU. It does it all. It offers amazing gaming performance and performance per watt, and it often beats out the 8-core 11900K and 5800X at multithreading. It adds PCIe 5.0 and DDR5 support for a bit of future proofing too. Then there's its price. At \$599 it offers exceptional performance for your dollar. Welcome back Intel! Now, AMD, it's over to you.

The 12600K offers a rather stunning level of performance for its price. It manages to beat out the 5800X in most cases, despite ostensibly being a six core CPU.

The Core i5-12600K is the real hero of the 12th Gen range. It's an amazing all-round CPU.

Chris Szewczyk

★★★★★



\$1,049 | www.intel.com

Intel Core i9-12900K

The new performance king.

Here we go folks. Say hello to the Intel Core i9-12900K, the flagship processor of the 12th Gen range. The 12900K packs in eight performance cores and eight efficient cores for a total of 24 threads.

The P-Cores can boost up to 5.1GHz while the E-cores can boost to 3.9. The 12900K contains the maximum available 30MB of L3 cache, Intel UHD770 Graphics and support for either DDR5-4800 or DDR4-3200 memory, though of course in reality it supports higher memory speeds than this.

The 12900K is clearly built to deliver the best possible performance at all costs, and we're pleased to say that it's a fantastic performer. Its multi-threaded performance is incredible. In CPU- and platform-related benchmarks, it utterly destroys the Ryzen 5900X and, though we didn't have a 5950X on hand for testing, it's certainly beating that CPU too in many cases despite its thread count disadvantage. It's not just multithreaded performance that's increased. Single threaded performance and gaming performance has taken a big step forward too, and we think there might be a bit of performance yet to come.

We get the feeling that either general software, Windows 11 scheduling or

Specifications

Intel Core i9-12900K; LGA 1700 socket; 8 P-Cores + 8 E-Cores, 24 threads; P-core Base/Max Clock Speed 3.2/5.2 GHz, Single E-core Base/Max Clock speed 2.4/3.9 GHz; 30MB Cache; 125W Base Power, 241W Maximum Turbo Power.

Intel's Thread Director tech has some room to mature. The *Ghost Recon* results are a case in point. The 12900K struggles to match the 11th and 12th Generation CPUs, while in *Shadow of War* the 12900K utterly blows them away by over 20 percent. If you want the best performing gaming CPU, the 12900K is it. That alone is a huge win for Intel. At a price of around \$1,000, it's pretty expensive, but for top tier performance it's reasonable (relatively) compared to how flagship CPUs have been priced in the past. It will surely drop in price once the early adopter premium pricing abates.

The 12900K has a lot of things going for it, but power consumption and temperatures are not among them. Even with a 360mm AIO, we saw temperatures hitting 90 degrees, along with a stratospheric 337W system power consumption over 10 minutes of Cinebench R23 testing. Make no mistake, the 12900K is a seriously power-hungry and hot CPU. If a 360mm AIO struggles, it's safe to say that anything less than a flagship tier air cooler will struggle to

keep it from thermal throttling. These characteristics take some shine off of what is otherwise an excellent all-round CPU. Luckily, idle power consumption is lower than 11th Gen CPUs, which is definitely worthy of praise.

We have to stop short of unequivocally recommending the 12900K. There's the very high power consumption levels, high platform cost and the requirement for a high-end cooler to tame it. There's also stiff competition from Intel's own very appealing 12700K and, in particular, this generations' superstar – the 12600K. Those things aside, the Core i9-12900K is a high-performance beast and for many users, that's really all that matters. If you're building a high performance desktop system, other than the more application specific HEDT platforms, there's nothing better right now. Overall, Alder Lake represents a return to form for Intel and we're quite sure that there's more to come as the software ecosystem matures to take maximum advantage of the hybrid architecture.

We have to stop short of unequivocally recommending the 12900K. There's the very high power consumption levels, high platform cost and the requirement for a high end cooler to tame it.

■
If you want to build a top spec desktop PC, the 12900K is the processor to do it with.

Chris Szewczyk

★★★★★

INTEL'S 12TH GENERATION CPU BENCHMARKS

Test bed specifications

Motherboard MSI Z690 Carbon Wi-Fi **GPU** Zotac RTX 3080 Ti Amp Extreme Holo **Memory** 2x16GB G.Skill Trident Z5 DDR5-6000 C36 **Storage** Team Cardea A440 2TB NVMe SSD **Power Supply** Corsair AX1000 **Case** Thermaltake Core P8 **Cooling** MSI MEG CoreLiquid S360 **OS** Windows 11 Build 22H2.282

	AMD Ryzen 7 5800X	AMD Ryzen 9 5900X	AMD Ryzen 7 3700X	Intel Core i5 10600K	Intel Core i9 10900K	Intel Core i5 11600K	Intel Core i9 11900K	Intel Core i5 12600K	Intel Core i9 12900K
Handbrake 1.4.2 Video conversion 4K to 1080p FPS	56.1	72.4	48.4	40.9	55.1	47.5	57.9	66.4	83.0
Cinebench R23 Rendering - Multi-thread Score	15,588	20,988	12,126	9,190	15,943	10,943	15,282	17,045	27,229
Cinebench R23 Rendering - Single-thread Score	1,593	1,598	1,278	1,272	1,341	1,524	1,596	1,883	2,000
Blender 2.92 Classroom Render Time (seconds) Lower is better	411	297	515	693	381	591	421	401	254
7Zip 21.03 File Compression Billion Instructions per second	109.04	136.40	86.74	60.26	102.76	68.14	91.97	93.27	134.1
PQV-Ray 3.8.0 Ray Tracing - Pixels Per Second	5,615	7,228	4,335	3,839	6,742	4,432	6,110	6,564	9,976
CPU-Z Multi-Thread Score	6,835	9,563	5,509	4,073	7,382	4,720	6,585	6,961	11,369
CPU-Z Single-Thread Score	666	674	526	545	580	636	693	759	820
Peak System Power Consumption Wall Draw (watts)	213	219	160	180	314	241	298	222	337
Geekbench 5.4.2 Multi-Thread Score	11,147	14,488	9,379	7,352	11,705	8,537	11,122	13,177	19,035
Geekbench 5.4.2 Single-Thread Score	1,715	1,715	1,324	1,313	1,433	1,731	1,816	1,814	2,007
PCMark 10 Extended Score	11,656	11,731	9,910	10,040	10,519	10,807	10,995	11,531	12,623
AS SSD Read Score	4,390	4,163	3,835	3,363	3,606	4,213	4,497	4,389	4,379
AS SSD Write Score	5,238	5,534	4,086	2,965	3,504	4,206	5,534	5,293	5,414
3DMark TimeSpy Extreme Overall score	9,234	9,814	8,683	8,192	9,591	8,601	9,348	9,184	10,076
3DMark TimeSpy Extreme CPU Score	5,715	7,730	4,535	3,780	6,769	4,426	6,117	5,790	8,942
Civilization VI 1080p, Ultra, DX12 Avg FPS	288	287	217	207	276	226	275	294	287
Civilization VI 1080p, Ultra, DX12 Min FPS	179	187	167	152	190	175	201	201	201
Civilization VI 1080p, Ultra, DX12 AI Turn Time	7.65	7.45	7.78	7.82	7.68	7.43	7.70	7.54	7.48
Ghost Recon: Breakpoint 1080p, Low, Avg FPS	217	235	193	201	230	212	222	226	231
Metro: Exodus Enhanced Edition 1080p, Ultra, DX12, Avg FPS	129.1	129.2	107.1	119.1	128.4	126.7	131.1	131.6	139.1
Metro: Exodus Enhanced Edition 1080p, Ultra, DX12, Min FPS	77.5	72.1	66.9	70.7	76.1	75.8	76.0	73.2	76.5
Middle Earth: Shadow Of War 1080p, Lowest Preset, Avg FPS	299	304	220	234	277	263	291	316	302



\$3,899 | rog.asus.com

Asus ROG Zephyrus G15 GA503Q

Asus's class-leading gaming ultrabook is back, but it doesn't mean you'll be able to find it in stock anywhere.

Asus's Zephyrus G range has been an outstanding performer over the last few years, topping a heap of our best gaming and best professional laptops list. The only downside of these devices has been that they're so in demand that they're actually sold out more often than not.

The Zephyrus G15 GA503 is no different in this regard, with everything but the most entry level units sold out anywhere we looked at the time of writing. All of the Zephyrus G15 units come with identical screens, an AMD Ryzen 9 processor, 16GB of RAM and a 1TB SSD, so the only option is what GPU you pair it with. At the entry level that could be an Nvidia RTX 3050Ti for a cost of \$2,399, and this ranges all the way up to the \$3,899 G15 with an RTX 3080. While we tested the latter, it's worth pointing out that the entry G15 packs a serious amount of power for the average user and would make an amazing professional ultrabook for anyone that just

Specifications

W10 Home; 15.6-inch IPS 165Hz display at 2560x1440 pixel resolution; 3ms response time; 100% DCI-P3, Pantone certified; AMD Ryzen 5900HS CPU; Nvidia GeForce RTX 3080 GPU; 16GB RAM; 1TB PCIe SSD; 90Wh battery (6h38min 1080p movie playback); 35.5 x 24.3 x 2cm; 1.9kg.

needs lighter gaming performance.

The 15.6-inch screen is a nice balance of speed and resolution offering QHD picture quality and a 165Hz refresh rate. The 2560 x 1440 pixel resolution makes the IPS panel look vibrant and the Pantone calibrated DCI-P3 colour palate means you get a professional level HDR experience that works equally well for gaming and professional applications. And while there are faster screens than 165Hz, it is more than fast enough for most users to play competitive online games without being a major additional expense. While the system does use an AMD CPU, the graphics cards available with it are all still Nvidia. Now that you do get basic cross-platform Adaptive-sync compatibility here, the unit

doesn't opt for expensive G-Sync certification. This is really a sensible cost/benefit decision for the average user.

The AMD Ryzen 9 5900HS processor is between 10 and 31 percent faster than its predecessor the 4900HS and it's pretty much on par with Intel's Core i9-11980HK so it was just about the fastest laptop processor you could get until Apple launched the M1 Pro, which outperforms it by between 8 and 35 percent (depending on the test). Still the 5900HS is one of the most powerful chips you can get on consumer laptops and if you pair it with an Nvidia RTX 3080 GPU you'll be able to push over 60fps on FullHD Ultra in basically any game.

If you look at the ROG Zephyrus G15 against the similarly priced MSI Creator Z16, which has an RTX 3060 and a 120Hz screen you're getting a serious GPU and screen upgrade in a package that's a little thicker, but also a bit lighter (even though the G15 has a bigger battery). Lasting 6 hours and 38 minutes in movie playback and a similar time under load the Zephyrus G15 offers solid battery performance that should last for the better part of the day.

	Asus ROG Zephyrus G15 GA503Q	MSI Creator Z16
PCMark 10 - Overall (score)	7187	6,561
Cinebench R23 - CPU (multi-threaded)	11,489	9,984
3DMark Time Spy (score)	10,025	6,509
F1 2021 - Ultra 1080p (fps)	99	57
Battery life - 1080p video playback (h:min)	6h38min	4h18min
Peak CPU temperature (°C)	96	100
CrystalDiskMark Read (MB/s)	3,594	6,617
CrystalDiskMark Write (MB/s)	3,033	5,112

Asus's well-balanced gaming ultrabook offers great performance at a number of reasonable price points. **Joel Burgess**

★★★★★

\$849 + \$199.95 Type Cover | microsoft.com/en-au

Microsoft Surface Go 3

It might be called the Go range, but has Microsoft really let itself Go with this one?

Now into its third iteration of the Surface Go tablet, the segment is starting to mature... which is an interesting aspect for a budget laptop range. Normally, you'd expect to find some concessions in an entry level device, but similar to other Surface products, the iterative process has ironed out a lot of the kinks and results in a refined device that offers an exceptional level of functionality.

Up front the Surface Go 3 uses the same 10.5-inch PixelSense display with a 3 by 2 1920x1080 pixel resolution touchscreen display as its predecessor. This screen has a 400nit typical brightness with a 1:1500 contrast ratio and 10-point capacitive touch, so you don't really need much more in terms of visual quality or usability than what's already on offer.

It's also got pretty much the same RAM options and while the Intel Pentium Gold 6500Y is technically a new processor released in 2021, it's built from the same components as the Intel Core m3-8100Y that were on the most expensive Surface Go 2s. The only significant difference then is that there's no longer an LTE option, which if we think about it, was an unnecessary premium feature that



Specifications

Windows 11 Home in S Mode; 10.5-inch PixelSense display at 1920x1280 pixel resolution; Intel Pentium 6500Y CPU; 8GB RAM; Intel UHD Graphics 615; 128GB PCIe SSD; 27.5Wh battery (7h33min 1080p movie playback); 24.5 x 17.5 x 0.8cm; 544g.

those looking for a budget 2-in-1 can easily live without.

The Intel Pentium Gold 6500Y is a step forward from the more affordable options of the last generation in terms of CPU performance, adding somewhere between 20 percent and 40 percent to the processor scores.

Unfortunately there's also a serious drop in graphical performance with the GPU taking a hit of between 16 and 78 percent depending on the benchmark. This is a seriously disappointing development and means that even light gaming and GPU heavy tasks will be a challenge

on this device. While the Surface Go 2 could get 42fps on *Rocket League* using 'Performance', HD settings the graphical performance drop in the Go 3 means this game is no longer playable, under any settings.

This means that the only upgrade on the Surface Go 3 is the inclusion of Windows 11 S Home, which is a nice visual upgrade to Windows, but one that really isn't transforming the OS in a way that means you need to upgrade. The features are softer and the system search functionality was finally fixed to avoid defaulting to a web search, but there's even some contention about the Windows 11 UI layout, so it's not enough of a feature to counterbalance the Go 3's regressions in other areas.

The Surface Go 3 Type Cover still forms an essential part of the Surface Go's identity, and it's good enough that we wouldn't really consider this device without it. The keyboard is nice to type on for an ultra compact and there's all the latest Wi-Fi and Bluetooth connectivity. To be frank the Surface Go 3 is still a great portable 2-in-1 offering, it just hasn't changed much in the last few years as the competition in the budget portable offering has really heated up.

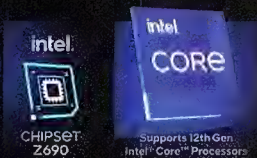
Unfortunately there's also a serious drop in graphical performance with the GPU taking a hit of between 16 and 78 percent depending on the benchmark. This is a seriously disappointing development and means that even light gaming and GPU heavy tasks will be a challenge on this device.

	Microsoft Surface Go 3	Microsoft Surface Go 2
PCMark 10 - Overall (score)	2,529	1,942
Geekbench 4 - Multi-Core (score)	5,999	4,228
Geekbench 4 - Compute (score)	15,731	28,010
3DMark Fire Strike (score)	565	835
Battery life - 1080p video playback (h:min)	07:33	07:58
Peak CPU temperature (°C)	88	54
CrystalDiskMark Read (MB/s)	1,580	1,784.1
CrystalDiskMark Write (MB/s)	427	848.35

A great budget laptop that hasn't improved much over the last few years.

Joel Burgess

★★★★☆



THE NEXT LEVEL UP IN PERFORMANCE

MAXIMISING YOUR 12TH GEN INTEL SYSTEM WITH AN AORUS Z690 MOTHERBOARD

Intel's new 12th Gen platform has arrived! Whether you're a content creator, mega multitasker or gamer, there's a 12th Gen processor to suit you. Of course, the CPUs themselves are just a part of the platform. There's a brand-new range of awesome AORUS motherboards to suit the budget of any gamer and enthusiast.

Introducing the AORUS Z690 motherboard range

AORUS motherboards are built with the needs of gamers in mind, and enthusiasts will find an AORUS model suit. A user that wants absolutely

everything will want to look at the flagship AORUS XTREME, which includes essentially every conceivable 2022 feature. If you want to show off your water-cooled rig, there's the gorgeous and feature packed AORUS XTREME WATERFORCE.

The Z690 AORUS MASTER and AORUS ULTRA will find their way into many gamers' rigs. These ever-popular models offer a great blend of all the features, while offering terrific value.

GIGABYTE offer many mid-range boards to suit your needs and budget including the PRO, ELITE and ULTRA series. GIGABYTE hasn't forgotten

small form factor fans either. You'll want to take a look at the Z690M AORUS ELITE and Z690I AORUS ULTRA. GIGABYTE also know that many gamers have DDR4 memory that they're happy with. With that in mind, there are many AORUS options that support DDR4 memory. All of the PRO, ELITE and ULTRA models are available with either DDR4 or DDR5 options. You can save some money while still enjoying everything that a 12th Gen CPU paired with an AORUS Z690 motherboard has to offer.

Let's take a look at some of the features that makes AORUS boards so appealing.

Bulletproof VRM designs

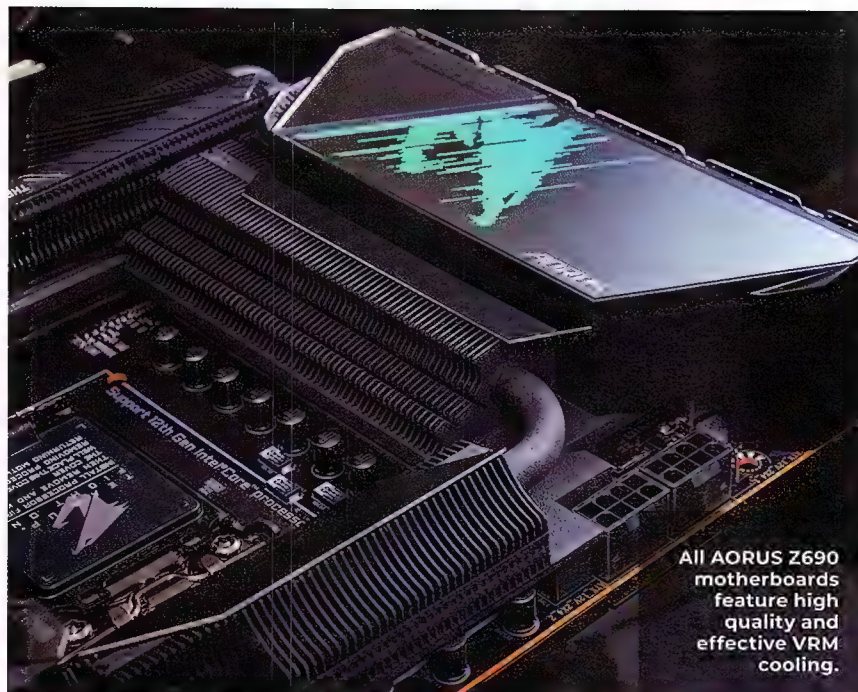
Across the entire range, AORUS motherboards have high quality direct digital VRM designs, with stronger, more efficient and reliable components than ever before. So, whether you want your rig to stay cool and quiet, out of sight and mind, or you want to overclock to the max, you can rest assured that your AORUS board will take all the punishment you can throw at it, and then some.

Premium cooling

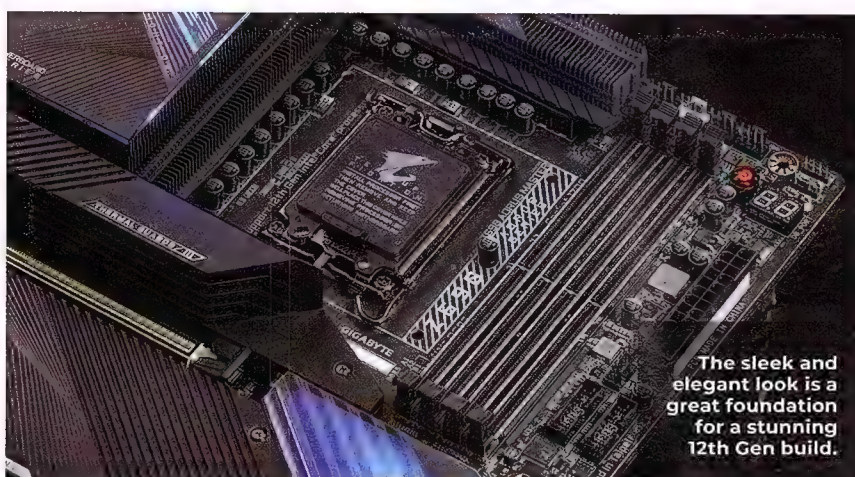
A strong VRM needs capable cooling. AORUS boards feature an Xtreme Thermal Design. Unlike some other VRM cooling designs, the AORUS Fins-Array III with its NanoCarbon



Build your new Intel 12th Gen system around one of the new AORUS Z690 motherboards, and enjoy all the features and performance you deserve.



All AORUS Z690 motherboards feature high quality and effective VRM cooling.



The sleek and elegant look is a great foundation for a stunning 12th Gen build.

coating and Direct-Touch heatpipes is built to perform. It features a massive surface area, helping to keep your VRM cool while still looking great!

On the topic of cooling, GIGABYTE knows how important it is to keep your M.2 NVMe drive running cool to maintain maximum performance at all times. The AORUS M.2 Thermal Guard Xtreme provides effective SSD cooling thanks to its Fins-Array design, complete with a heatpipe and NanoCarbon coating. This means your SSD will stay at peak performance for longer under the most punishing loads.

Engineered to extract the best from DDR5 memory

DDR5 is brand new, but GIGABYTE's engineering prowess comes to the fore yet again. All AORUS motherboards are built from the ground up to support this new technology. AORUS boards are all designed with the most efficient signal routing for improved stability, even at the high memory clocks. The SMD stainless steel slot design adds durability too, so in the years to come, an AORUS motherboard can be ready to meet the demands of increasingly fast DDR5 memory modules.

Connectivity for 2022 and beyond

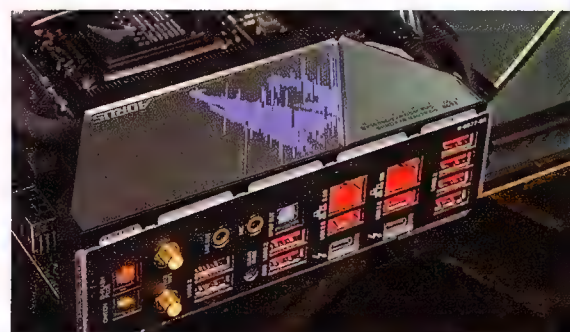
AORUS Z690 motherboards incorporate all the latest in connectivity and expansion options. Even the more affordable boards are packed with features that would have been exclusive to flagship boards just a generation or two ago. All AORUS Z690 boards come equipped with USB 3.2 Gen 2x2 along with a Type-C header for connection to a chassis with Type-C USB.

When compared to their predecessors, AORUS boards come with more PCIe 4.0 M.2 slots. Most ATX AORUS boards support up to four at the same time (the AORUS MASTER supports five!). So, you can safely run your OS and game libraries and still have slots left over for your miscellaneous storage.

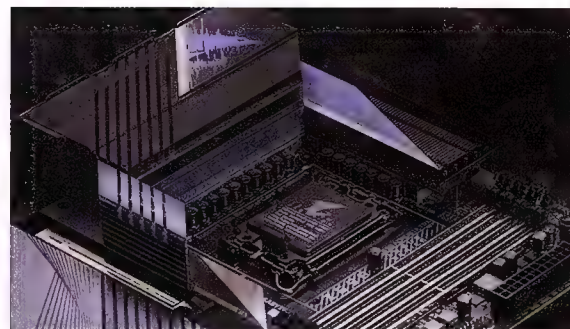
FIND OUT MORE

Discover all the features and benefits of the AORUS Z60 motherboard range at the Aorus YouTube channel [youtube.com/watch?v=MFMiRmbnSn0](https://www.youtube.com/watch?v=MFMiRmbnSn0)

And read up on these new performance products at the AORUS product page: aorus.com/en-au/motherboards/intel-z690-series



Connectivity and the latest Wi-Fi 6 support is generous across the AORUS range.



Engineered to keep the components cool, while looking fantastic.

Networking for gamers

Anyone that's had experience with Wi-Fi knows how dropouts, lost packets and slow pings can ruin your gaming experience. The need for reliable Wi-Fi is vital. AORUS has you covered with Wi-Fi on almost all models. The AORUS Smart Antenna with its omnidirectional 4dBi signal gain helps to ensure you maintain the best possible connection, helping to ensure that your headshots hit where they're supposed to.

If you prefer wired networking, there's good news. All AORUS Z690 motherboards come equipped with 2.5G Ethernet. Say goodbye to 1999 era 1G Ethernet! The AORUS MASTER and XTREME come with 10G for the lowest pings and fastest file transfers.

Get the most out of your game with AORUS

So, no matter your budget, there's an AORUS motherboard to suit you. An AORUS motherboard paired with your choice of 12th Gen processor can elevate your game to higher levels than ever before. Even the more affordable boards can never be considered 'budget' thanks to loads of features, and all are designed with GIGABYTE's legendary reliability and durability in mind.



From \$2,999 (14-inch), \$3,749 (16-inch) | apple.com/au

MacBook Pro 14 & 16 (2021)

Apple's new M1 Pro and Max processors pack a punch, but is the 2021 MacBook Pro really the perfect package?

The late 2020 Macbook Pro 13 and MacBook Air models introduced the revolutionary M1 processor, which fundamentally shifted the parameters of laptop efficiency. Many, however, predicted that the next iteration of Apple's in-house SoC would test just how far Apple can push the M1's performance envelope. Turns out the RISC processors that were almost exclusively found in smartphones and tablets before the M1, can actually be amazingly powerful, at least when Apple is building them.

On the handful of benchmarks where you can actually compare them, both the 10-core M1 Pro and M1 Max chips are capable of outpacing the most powerful laptop processors from either AMD or Intel. That's a five percent performance bump over the AMD Ryzen 9 5900HS and a 12.9 percent improvement on Intel's i9-11980HK in Cinebench R23 scores. If you add this to the even bigger jumps you'll see in Geekbench 5 scores, we can definitively say that if you want the most powerful consumer laptop CPU today, you'll have to buy an Apple.

Low power, high performance

What's perhaps even more amazing is that the M1 Pro and M1 Max achieve this result with a 30W CPU power draw, which is 5W lower than the AMD 5900HS TDP and 15W lower than Intel's top 11th gen i7 and i9 laptop CPUs. Apple's 5nm chips can beat some current 8-core 11th gen i7 laptops using 70

Specifications

14.2-inch 3024x1964 or 16.2-inch 3456x2234 pixel 120Hz Liquid Retina XDR display at 254ppi; Apple M1 Pro with 14 or 16-core GPU, or Apple M1 Max with 24 or 32-core GPU; 16 to 64GB of Unified Memory; 512GB to 8TB of SSD Storage; 69.6Wh battery (15h movie playback) or 99.6Wh battery (9.5h movie playback); 31.3x22.1x1.55cm, or 35.6x24.8x1.7cm; 1.6 or 2.2kg.

percent less power. Intel's 10nm SuperFin Tiger Lake processors and even AMD's TSMC 7nm FinFET are a way off the M1 chip's efficiency – especially when not running full tilt – so it means that you're getting both more computer power and longer battery life on the MacBook Pro 2021, from an equation where one is normally traded for the other.

While you can get an 8-core M1 Pro CPU on the MacBook Pro 14 for a \$300 saving, all other models of the M1 Pro and M1 Max processors use the same 10-core CPU. Comprised of eight high performance cores and two efficiency cores, the 10-core M1 CPU offers an average 70 percent performance bump over the original M1 processor and an 18 percent improvement over the late 2019 MacBook Pro 16 (9th gen Intel i9). While the CPU component is relatively consistent across these two chips, the GPU capacity and memory configuration vary considerably across the two.

The M1 Pro comes with either a 14- or 16-core GPU and either 16 or 32GB of Unified Memory that runs at a max speed of 200GB/s, while the M1 Max features a 24- or 32-core GPU with 32 or 64GB of Unified Memory at a 400GB/s bandwidth. Apple's GPUs are arguably better suited to graphical work than they

are for gaming thanks to the generous allocation of Unified Memory available to it, but even the original M1s were capable of entry level gaming on the selection of titles available for MacOS. The 16 Core M1 Pro GPU was around 85 percent better in graphical benchmarks than the original M1, which translated into around 35 percent better framerates in *Sid Meier's: Civilization VI*. The 32-core M1 Max on the other hand offered over three times the graphical performance of the original M1 in benchmarks and *Total War Saga: Troy* framerates. In terms of comparative performance, the M1 Pro 16-core GPU offers about twice the performance of Intel's integrated Iris Xe Graphics while the Max 32-core GPU performs roughly the same as an Nvidia RTX 3050 Ti GPU.

Looking good

The other major update on the new MacBook Pro range is the display. Apple has always offered an excellent colour gamut and professional level DCI-P3 colour certification, but the company is leveraging its Liquid Retina LCD display technology used on some iPhones and iPads for a new screen that roughly doubles the average peak brightness of its predecessors. The new tech uses miniLED backlighting to dramatically



Apple's GPUs are arguably better suited to graphical work than they are for gaming thanks to the generous allocation of Unified Memory available to it, but even the original M1s were capable of entry level gaming on the selection of titles available for MacOS.

enhance the brightness from around 500 nits on the 2019 MacBook Pro 16, to a sustained 1000 nit brightness on the new screens. While this does make the screen a little brighter, what you notice most is really the improved colour sharpness and deeper blacks thanks to the localised backlighting.

While neither the 14.2-inch 3024 x 1964 pixel, nor the 16.2-inch 3456 x 2234 pixel Liquid Retina XDR displays are quite 4K resolution; both offer much higher resolutions than QuadHD in an aspect ratio of somewhere between 16:10 and 3:2. Combine this with the new 120Hz ProMotion refresh rate and the 254ppi displays really do look a lot like an OLED display.

It's not just the major areas that have seen improvement, Apple has also overhauled all those smaller mundane features to ensure the best day-to-day performance possible. First up is the reintroduction of the MagSafe power

cable, which will be a major sigh of relief for anyone needing to charge their laptop somewhere other than their desk. The keyboard on the MacBook pro 14 and 16 models is a little different to what the company has been doing the past few years, too. Apple's quietly ditched the Touch Bar in lieu of a trusty set of 'dumb' function buttons that have features baked into them. The power button includes a fingerprint reader that now sits inside a recessed disk to increase accuracy – an important addition since the MacBook Pro laptops don't have the Face ID sign in features of the iPhone and iPads. Perhaps the most striking feature is the 'double-anodised' black well that the chiclet keyboard sits in, making the keys appear more uniform with their surroundings, without losing functionality.

Ticking all the boxes

The late 2020 MacBook Pro 13's had

revolutionary battery life and while these new devices have really efficient processors, they just aren't going to last quite as long as the original M1 devices. That said, we were able to stretch to just over 15 hours of 1080p movie playback from the MacBook Pro 14 and nine and a half hours from the MacBook Pro 16. That MacBook Pro 14 score is a longer lifespan than we've got from any other ultrabook manufacturer, even if it is a few hours behind the MacBook Pro 13. It is worth noting that this processor's efficiency means you can get a little over four hours of battery while gaming or under intense workloads on the M1 Pro, a feature that you'll struggle to find elsewhere.

There's also a suite of other dedicated processors and software optimisations that mean everything from the 5GB/s+ transfer speeds to the AI processing and Media encoding are top notch. You will be able to find alternate ultrabooks with better graphical capabilities (at least for gaming), but none with a battery that'll last more than a few hours under load.

The new MacBook Pros are the most powerful and efficient Ultrabooks available for pro workloads and light gaming, if you're happy to pay a premium for battery life.

Joel Burgess

★★★★★

	Apple MacBook Pro 14 M1 Pro	Apple MacBook Pro 16 M1 Max	MacBook Pro 13 M1 Late 2020
Geekbench 5 - Single-core (score)	1,774	1,774	1,723
Geekbench 5 - Multi-core (score)	12,525	17,134	7,562
Geekbench 5 - OpenCL (score)	37,120	60,630	19,700
Geekbench 5 - OpenCL Alternate GPU - Metal (score)	41,447	67,206	22,294
CrystalDiskMark 6 - Sequential read (Q32T1)	5,662	5,673.8	2,829
CrystalDiskMark 6 - Sequential write (Q32T1)	5,077	5,078	2,293
Cinebench R23 - GPU	12,372	12,384	7,586
Cinebench R23 - CPU (Single Core)	1,530	1,534	1,517

\$3,999 | au.msi.com/Content-Creation/Creator-Z16-A11UX

MSI Creator Z16

MSI reckons its Creator laptops could inspire the next generation of Renaissance artists, but has it done enough to draw in the designers?

MSI has always had its Prestige range aimed at business and creative professionals, but it's pushed particularly hard into the more artsy side of this space over the last couple of years. The Creator range, which was released this year, is perhaps the culmination of this effort, offered in 15-inch, 16-inch and 17-inch models, the ultrabook laptops feature Nvidia GPUs and high resolution, colour-accurate screens that meet all the needs of visual professionals.

The Creator Z16 has a 16-inch, regular LED, touchscreen display in a 16 by 10 QHD+ resolution that's a little more price conscious than the OLED and MiniLED screens on the Creator 15 and 17 units. While it's not the most cutting edge screen technology, this display has been designed to a level that makes it suitable for professionals that need to work with precise colours.

In collaboration with Portrait Displays, MSI has got the screen Calman Verified for 100 percent DCI-P3 colour reproduction. It's also got factory calibrated colour presets with a Delta E of less than 2 for guaranteed digital colour work. This makes it perfect for videographers, 3D animators and basically anyone else that needs precise colour in a digital space. MSI doesn't mention the Adobe RGB coverage, so the screen won't necessarily be suitable for creatives that are more interested in stills or swapping between real world and on-screen colour, but it will suffice for the majority of digital creative applications.



Specifications

W10 Pro (free W11); 16-inch touchscreen 120Hz display at 2560x1600 pixel resolution (16:10); 100%DCI-P3; Intel Core i9-11900H CPU; Nvidia GeForce RTX 3060 (TPD 65W); 32GB RAM; 87Wh battery (4h18min 1080p movie playback); 359 x 256 x 15.9mm; 2.2kg.

Supporting this screen is the choice of an Intel i7-11800H with either 16GB or 32GB of RAM or an Intel Core i9-11900H CPU with 32GB of RAM. While the first two here retail for \$3,499 and \$3,799 respectively, the top spec i9 unit is only a couple of hundred more at \$3,999. These prices aren't exactly cheap, but they're also not exorbitant considering they meet most of the essential specifications for creative professionals.

We never expected to ever compare an MSI laptop to an Apple one, but when you look at the specs, performance, the screen and the price, MSI's Creator Z16 is about as close to the MacBook Pro 16 (late 2019) as you can get. It's a little weird considering Apple released this unit about two years ago now, and while the Z16 does offer more RAM or more storage (depending on the configuration) and newer GPU and CPU offerings, in areas like screen

resolution the MacBook Pro 16 (late 2019) is still better.

That said, the Creator Z16 does have the latest octa-core CPUs, offering a 20 percent performance bump over the MacBook Pro 16 (2019). When you're running synthetic benchmarks and professional applications the Nvidia RTX 3060 GPU does also offer over four times the power of integrated Intel Iris Xe Graphics and 2.5 times the graphical power of the MacBook Pro 16's AMD Radeon Pro 5500M GPU.

Considering MSI's core branding on the Creator Z16 is 'Tech meets Aesthetic' we were a little disappointed to find we didn't really like the overall design. The exterior clamshell is fine and the outside vents even look pretty good (in a sportscar kind of way), but the hinge design is boring and the perforated above-keyboard grille, angular keyboard recession, and RGB backlit keyboard all look more like gaming accents than something anyone would consider stylish.

The keyboard is also a little too shallow and mushy to create an amazing typing experience and the battery life was disappointing. So while the MSI Creator Z16 really doesn't make any major missteps, we also wonder if it offers enough unique features to catch the eye of any cashed up designers.

A decent creative workstation that's just lacking in any outstanding features.

Joel Burgess

★★★★☆

	MSI Creator Z16	Dell G15
PCMark10 - Overall (score)	6,561	6,647
Cinebench R23 - CPU (multi-threaded)	9,984	11,851
Geekbench 5 - Multi-core (score)	8,285	7,924
3DMark Time Spy (score)	6,509	8,107
Battery life - 1080p video playback (h:min)	4h18min	4h13min
Peak CPU temperature (°C)	100	98
CrystalDiskMark Read (MB/s)	6,617	2,824
CrystalDiskMark RWrite (MB/s)	5,112	1,411



\$429 | www.corsair.com

Corsair Virtuoso RGB Wireless XT

The Swiss army knife of gaming headsets.

Everything. That's what I imagine the answer was when Corsair asked what it should build into the new Virtuoso XT headset. Just make it do everything. And sure enough that's what it did. Rock solid wireless capability? You're covered. Bluetooth connectivity? Of course. PlayStation Support? Yep. High fidelity 24bit/96kHz audio? Pfft, do you even need to ask? Even the venerable 3.5mm jack makes a return.

The XT is a good-looking headset with a subdued but stylish design that sits equally comfortable in a business class flight lounge or your next esports tournament. An aluminium chassis and machined edges give the XT a lovely premium look. The earcups include an adjustable RGB Corsair logo, allowing you to go full gamer. You can also disable the RGB if you want to be more subtle. In combination with the removable mic arm this allows the headset to blend into any environment whether gaming or everyday use.

Comfort is great too. The headband is nicely padded and supports plenty of adjustment, with marked notches so you can easily adjust back to a known position. The round memory foam earpads sit comfortably against your head and are big enough to ensure a good fit in most cases.

I never had any issues with fatigue or discomfort while using the XT. While I do have fairly large ears I had no issues with them touching the

Specifications

Connectivity: 2.4GHz wireless, Bluetooth, USB Wired, 3.5mm wired with inline controller.
Surround Sound: Yes (Dolby Atmos); Headset Frequency Response: 20Hz - 40 kHz; Headset Battery Life: Up to 15 hours; Microphone: 9.5mm omni-directional, high-bandwidth detachable microphone; Weight: 382g.

earpads. But earpad fit is personal, and conveniently the XT supports replaceable earpads with a range of aftermarket options if the standard fit doesn't work for you.

So it looks good, is comfortable, and can connect any conceivable way. But how does it sound? In my view the XT is one of the best gaming headsets in terms of audio quality. Its two 50mm neodymium drivers provide clear mids and crisp highs coupled with reasonable bass. For my personal taste the very low bass range needed a bit of a boost, and the mids were a bit overrepresented. But both were easily adjusted with an easy tweak in the software EQ.

The mic is in a different league to other gaming headsets. I use voice recognition extensively, and noticed a marked improvement in the percentage of recognised commands when using the XT. My online friends also commented on the improved mic quality as soon as I switched.

The XT requires Corsair's iCUE app to control the headset's RGB, EQ and other settings. For some this will be an issue as not everyone is a fan. Not running iCUE means you forgo RGB, which is fine, but it also means you cannot apply a custom EQ, which is a big loss. Luckily the 'do everything' XT

does provide another option. It ships with Dolby Atmos, which allows you to apply EQ settings via the Dolby Access app (so no need to run iCUE), while also providing great spatial audio.

The one feature I initially missed on the XT was the ability to separately control game and comms audio (e.g. Discord) from the headset. This is a very useful feature of my current GSP670 headset and as standard is missing from the XT. But the Swiss army knife XT again comes through with an alternative solution. It supports simultaneous wireless and Bluetooth audio, with independent control on the headset for each. So set up comms audio over Bluetooth and game audio on wireless and hey presto – separate controllable game and comms audio. Even better, you can run Discord on your phone, removing one more background app from your gaming PC. Now that's cool. Well played Corsair.

■
The Corsair Virtuoso XT is an extremely versatile headset combining great audio with every conceivable type of connectivity, in a form factor and design that foregoes the typical gamer aesthetic for something that can be used anywhere for anything. **Pete Veedub**

★★★★☆





\$399 | www.corsair.com

Corsair H100i iCue Elite LCD AIO Liquid Cooler

Ultra-premium cooling for the well heeled.

Corsair led the way with AIO liquid cooling, and though it's a little late to the party as far as LCD-equipped coolers go, it's made up for it with a truly premium entrant. Though its price will turn off a lot of buyers, if you're looking for a top end Corsair cooler to incorporate into your build, you'll want to check it out. We have the 240mm iCue H100i Elite LCD on hand. There are 360mm and 420mm versions available if you need more cooling capacity. Notably, the H100i Elite series of coolers come with Intel 12th Gen LGA 1700 support out of the box. Its main highlights are the excellent ML120 ARGB fans and, of course, the 2.1in LCD panel.

The Corsair H100i Elite LCD isn't the first display-equipped AIO, but Corsair really did an amazing job with regards to the amount of customisation on offer. The IPS LCD screen boasts a 480 x 480 resolution and 16.7M colour support. It can be used to display monitoring information, images and GIFs though it doesn't support video playback. Many of the various elements, LEDs

Specifications

480x480 2.1in IPS display; 2x ML Elite series 120mm fans; 380mm Tube length; Intel 1700, 1200, 1150, 1151, 1155, 1156, 1366, 2011, 2066 & AMD AM4, AM3, AM2, sTRX4, sTR4 compatible; max 30.4dB(A) Noise Level.

and text colours can be changed. If you like the Elite LCD, you can purchase an LCD upgrade kit for Elite Capellix series coolers. That's a nice way to upgrade an existing cooler.

The unit comes with a Corsair iCue Commander Core smart controller. It can control six PWM fans with RGB. As it can be placed behind the motherboard tray or out of sight, and it's a great way to get rid of unsightly fan cables that would otherwise require motherboard headers. Owners of Corsair cases and fans will find the Commander Core particularly handy.

The H100i LCD isn't all bling. The ML120 RGB Elite fans are very good indeed and they go some of the way to justifying the high price tag of the unit. They remain very quiet until they move over about 1,200 RPM. For all the talk of aesthetics, an AIO has to cool and the Corsair H100i Elite LCD does so very well. We used it to cool an AMD 5800X inside a Razer Tomahawk

ATX case and compared it to an EKWB AIO Basic 240mm. The Corsair was able to beat the EK unit and do so at a lower noise level, though in fairness the EK unit is much cheaper. The ML120 fans really shine. Literally and figuratively.

The only real weakness of the H100i Elite LCD is its price. At \$399 for a 240mm cooler, it's very expensive and well into premium 360mm territory. We hope street pricing settles lower than that. If you can stomach the price and you have a premium Corsair system then you'll want to check it out. It cools well and it's very quiet thanks to the excellent ML120 fans. We love the Commander controller, the iCue software works well and its extensive RGB support means you can customise it to your hearts content. Again, that price though! It's tough to ignore that Corsair and others offer decent 240mm coolers for half the price or less. If you just want a cooler, then look elsewhere but then the H100i LCD is more than just a cooler.

The Corsair H100i Elite LCD isn't the first display equipped AIO, but Corsair really did an amazing job with regards to the amount of customisation on offer. The IPS LCD screen boasts a 480 x 480 resolution and 16.7M colour support. It can be used to display monitoring information, images and GIFs though it doesn't support video playback.

■
The Corsair H100i Elite LCD is gorgeous and capable but its price tag will turn off most buyers.

Chris Szewczyk

★★★★☆



\$409 | www.ttpremium.com.au

Thermaltake ToughLiquid Ultra 360

Luxurious high-end liquid cooling.

Most people will laugh at the idea of spending \$400+ on a CPU cooler, and they'd mostly be right. Sure, you can get an ordinary liquid cooler for \$100 or so, but there's little that's ordinary about the Thermaltake ToughLiquid Ultra 360. This one is unmistakably a high-end cooler and thanks to its customisable pump head, you can integrate it into the theme of any build.

The TT ToughLiquid Ultra 360 is something of a departure for Thermaltake. It doesn't actually look that physically impressive. The fans lack RGB, there's very little in the way of branding, and the head unit looks quite bland when it's turned off. Don't assume that this makes the cooler itself ordinary. It definitely isn't! And once you turn it on, your attention is drawn towards the beautiful 480 x 480 LCD screen atop the pump head. Loads of RGB would just detract from that. We believe TT made a smart design choice there, though others would say TT should have included RGB fans. Looks are subjective. You decide.

The basics of 360mm AIOs are pretty much alike. The baseplate of the Ultra 360 is very large, which means proper

Specifications

Thermaltake ToughLiquid Ultra 360 AIO liquid CPU cooler; 400mm Tubes; AMD AM4, AM3(+), AM2(+), FM2, FM1, Intel LGA 1200, 115x, 2066, 2011(-3) & 1366 compatible; 3x Toughfan 120mm Turbo PWM fans; max 28.1dB(A) Noise Level.

contact is assured with all recent CPU generations apart from AMD's Threadripper. Installation is easy, if a bit fiddlier than some other coolers, and the whole unit feels hefty and well built.

The Toughfan 120mm fans are particularly worthy of praise. At 212g each they're as well-built as any consumer-level fan on the market. In fact, they sell for around \$39 each. They're optimised for high static pressure, which makes them ideal for use with radiators. They are the greatest attribute of the unit.

AIOs with a display atop the CPU block aren't new, but the Ultra 360's 480 x 480 2.1-inch LCD is notably sharp and vibrant. The Ultra 360 can display various monitoring parameters, and its default graphics look great. Of course, you can use your own custom GIFs. The easy to use TT software makes it easy to control both the display and the cooling settings. The display can be rotated but this means

the unsightly USB cable is rotated with it. AIOs are not the friendliest devices when it comes to cable management.

How does it perform? Very well! We used it with an AMD 5800X inside a Razer Tomahawk ATX case and compared it to Nzxt's Kraken Z73 360mm. We found it was able to match the impressive Nzxt but did so at a much lower noise level. That's a win. Clearly the Toughair fans are very good indeed and they go a long way to justifying the high asking price of the unit.

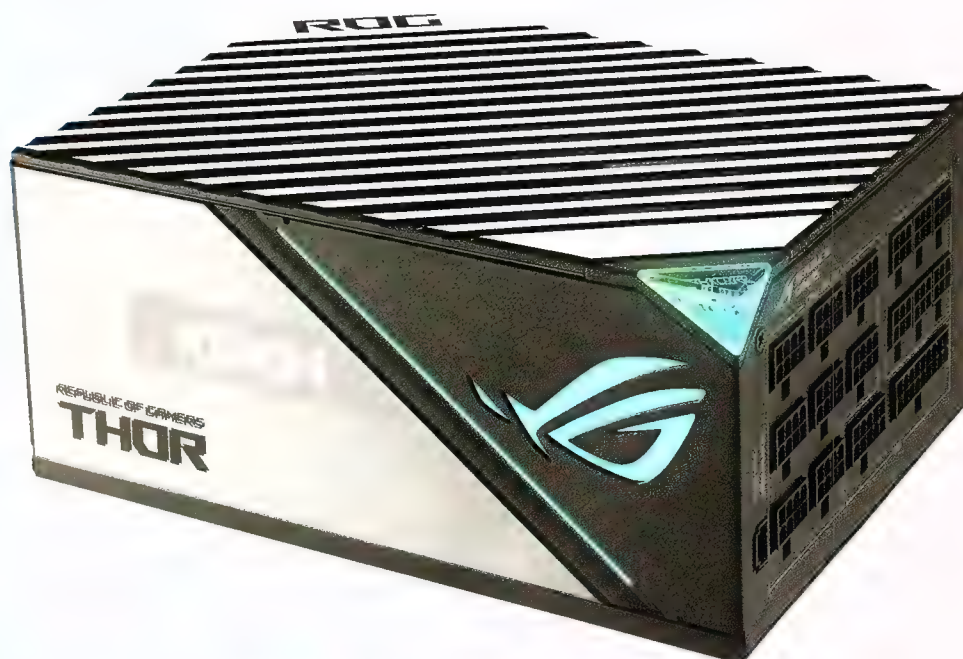
The TT Ultra 360mm is a very good AIO cooler. We personally like that TT focused on the display and cooling itself ahead of excessive RGB. The vibrant 2.1-inch display is beautiful and we love the Toughair 120mm fans. They manage to provide excellent cooling, while keeping the noise levels down. Apart from a USB cable routing niggles and the steep (though not totally unreasonable) price, TT has done a fantastic job with the ToughLiquid Ultra 360.

*It doesn't actually look that physically impressive.
The fans lack RGB, there's very little in the way of branding,
and the head unit looks quite bland when it's turned off.
Don't assume that this makes the cooler itself ordinary.
It definitely isn't!*

One of the best AIO liquid coolers on the market. Though it comes with a price to match.

Chris Szewczyk

★★★★★



\$539 | www.asus.com

Asus ROG Thor Platinum 1000 2 Power Supply

Bulletproof power for the most demanding rigs.

As the power requirements of modern PCs continue to increase, so does the need for a quality power supply to keep it properly fed. As graphics cards trend towards 400w+ TDPs with CPUs pulling 300w or even more, even an 850w PSU can be considered the baseline for a modern high-end gaming rig once you factor everything else in. Enter the Asus ROG Thor 1000w Platinum II. This thing is heavy metal. It's the most physically impressive power supply we've ever seen.

The premium metallic appearance of the Thor Platinum II is complimented by the small OLED panel that displays the power consumption of the system in real time – something Asus has adopted before. It can be a useful feature and we're surprised that more manufacturers haven't adopted something similar. It comes with addressable RGB support too. Is there a more premium looking design on the market?

With a power rating of 1,000w, the Platinum II will easily handle an overclocked CPU and GPU. At over \$500 we're surprised it doesn't come with an 80 Plus Titanium efficiency rating, making do with 80 Plus Platinum instead. The real-world difference is small but competing units

Specifications

Asus ROG Thor 1000W Platinum II ATX Power Supply; Fully Modular, 2x 4+4-pin CPU, 8x 6+2-pin PCIe, 1x 12-pin PCIe, 12x SATA, 6x Molex, Addressable RGB; 190 x 150 x 86 mm dimensions, 10-year warranty.

achieve it, so the Asus should too.

You'd expect a class leading PSU to feature a comprehensive set of connectors and the Platinum II 1000w does. The cables are sleeved too. Interestingly, it comes with a 12-pin PCIe power cable for use with Nvidia's RTX 30 Founders Edition cards and very likely future cards too, negating the need for an adapter.

We tend not to do many power supply reviews at APC due to the need for specialised (and expensive) test equipment. However, we can compare efficiency results by measuring the power consumption at the wall. We ran an overclocked i9-10900K system with an RTX 3080 GPU and ran a 3DMark looping test. The 80 Plus Platinum rated Platinum II recorded a peak wall draw of 474W. This compares to a Corsair AX1000 Titanium at 468W and an older Antec HCP1200 Gold unit at 487W. This kind of load doesn't stress the Thor, and it remains quiet at all times. Under typical loads, the fan doesn't spin at all thanks to 0db operation at under 50 percent load.

The Asus Thor Platinum II has some

very tough competition. The Seasonic Prime PX-1000 and Corsair HX1000 are both highly rated. Neither has the amazing presentation or OLED screen of the Asus Thor Platinum II, but they sell for well over a hundred dollars cheaper. That's impossible to ignore. It means we recommend the Asus as more of a showpiece PSU that's perfect for an artistic build in a windowed case, leaving the others as better choices for a more discrete build.

The Asus ROG Thor Platinum II is suited for high-end builds only. It demands to be shown off and that's its most compelling feature. At \$539 it's simply too expensive to recommend when you can get excellent and cheaper 1000W units from the likes of Corsair or Seasonic. A good PSU is an investment though. The Asus will see you through several rounds of upgrades. Its build quality and reliability will benefit your system in the long term. Make sure you're able to look at it though – hiding it out of sight would be a total waste.

The Asus ROG Thor Platinum II is suited for high end builds only. It demands to be shown off and that's its most compelling feature.

■
The Asus Thor 1000W Platinum II definitely looks the part, but its steep price counts heavily against it.

Chris Szewczyk

★★★★☆



\$219, www.corsair.com

Corsair HS80 RGB Wireless

Corsair's latest challenger for the crowded mid-tier gaming headset market.

Specifications

Connectivity: 2.4GHz wireless, USB Wired; Surround Sound: Yes (Dolby Atmos); Headset Frequency Response: 20Hz - 40 kHz; Headset Battery Life: Up to 20 hours; Microphone: non-detachable omni-directional; Weight: 367g.

The HS80 clearly takes some learnings from the excellent Virtuoso range and brings them to a more affordable price point. Audio quality is great, with 50mm neodymium drivers. The headset delivers clarity and balance, and while not quite matching the Virtuoso XT in audio fidelity it's not far off. The HS80 mic also copies its big brother in being one of the better gaming headset mics out there.

From a comfort perspective the HS80 is a pleasant surprise. The floating headband concept is not new nor unique to the HS80, but why wouldn't you follow a design that clearly works? The HS80's implementation is well done and delivers on the claim of being the most comfortable Corsair headset the company has made.

I was admittedly sceptical of the cloth earpads, which remind me of an 80s velour couch, but after a few weeks of using the HS80s I'm converted by their comfort. Bring back the 80s. And if you're not convinced after trying them yourselves, the HS80 does support replaceable earpads.

The all-black design of the HS80 looks nice, with a couple of RGB logos on the earcups, which can be disabled if RGB is not your thing. The mic is a non-removable flip-up-to-mute system, which provides a great tactile experience versus a mute button.

It is a good headset and does everything well. If you're in the market for a headset around the \$200 mark it deserves your consideration, though it lacks any stand-out features that would make it a clear choice above the rest.

A good headset that scores well in all the key areas, but doesn't do anything to really stand out from the competition.

Pete Veedub

★★★★☆



\$169.95 | logitech.com/en-a

Logitech MX Keys Mini

Masterful and compact.

Specifications

Tenkeyless design; Scissor switches with slim profile; Adaptive backlighting; Bluetooth or Logi Bolt USB receiver (not included); USB-C port; 5-month battery (10 days with backlighting on); USB-A to USB-C cable included; 131.95 x 295.99 x 20.97mm (HxWxD); 506.4g.

Ever since the launch of the MX Keys, I was hoping Logitech would grace us with a tenkeyless model, and now that it has it's everything I'd hoped for.

Costing a full \$60 less than its larger counterpart, the MX Keys Mini manages to offer the same quality, functionality and feature-set but in a more compact package. It even sports exactly the same battery life, lasting up to five months on a single charge (via USB-C) or ten days if you enable backlighting. This lighting is one of the major advantages the MX Keys series holds over the similarly sized and priced Magic Keyboard from Apple – the intensity of the key backlights adjusts automatically based on ambient lighting in the room, and disengages when proximity sensors detect inactivity in order to conserve battery.

New features arriving exclusively in the Mini model include dedicated keys for emojis, microphone muting and dictation, all of which are well suited to modern usage. As with the larger model, the keycaps have rounded indents that feel remarkably organic to use, and although the profile overall is rather slim, the keys have a little more travel than some modern laptop keyboards and achieve a delicate balance between sponginess and tactility.

With Logitech's Flow software, which allows you to fluidly connect to and switch between up to three devices via Bluetooth, as well as the MX Keys Mini being available in both agnostic or Mac layouts, there are very few people that the current range doesn't cater to. If you're not after mechanical switches and are keen on something compact, refined and functional, the MX Keys Mini definitely ticks all the boxes.

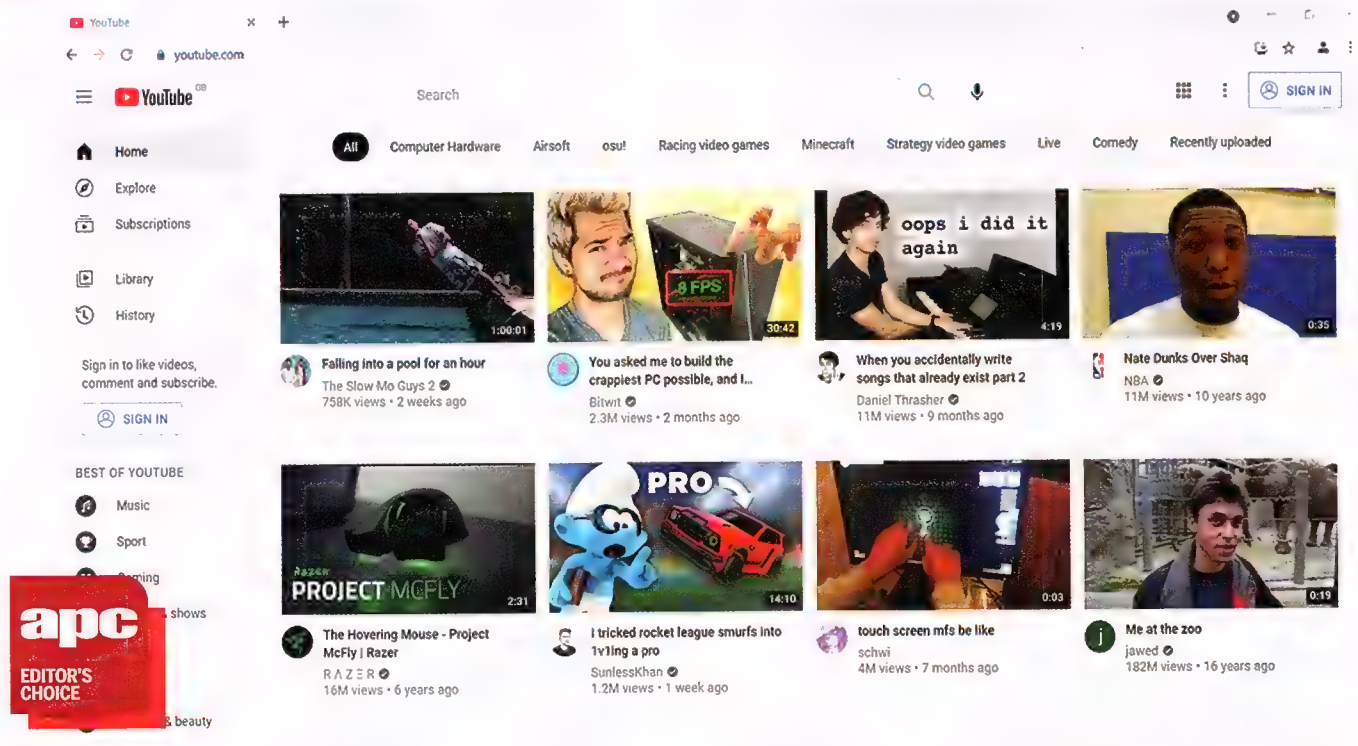
The MX Keys Mini brings the success and premium simplicity of its larger sibling to the tenkeyless crowd.

Harry Domanski

★★★★☆

SOFTWARE

APPS FOR ALL YOUR PLATFORMS



WINDOWS/BROWSER

YOUTUBE Free / \$14.99 (per month) | www.youtube.com TWITCH Free / US\$5 (per month) | www.twitch.tv.com

YouTube vs Twitch

Which of these video broadcasting giants is better?

Video streaming can be split up into several different sectors: Most TV channels have an additional website for catch-up TV; there are subscription sites, such as Netflix, Amazon Prime, and Disney+, that charge a monthly fee to watch on-demand films and TV series; and then there are websites, such as YouTube and Twitch, that host unique content in the form of video clips or live streaming videos. These sites have helped the internet take over from traditional television as an entertainment medium. So, in this issue's head-to-head, we're going to focus on these two giants.

Now one of the main players in the online video industry, YouTube had humble beginnings. In 2005, Steve Chen, Chad Hurley, and Jawed Karim had the idea of a platform where people could share 'home videos'. These three ex-PayPal employees made this idea a reality and named it YouTube. Back then, the concept of an online space where people could find and watch unique content was revolutionary.

The first video on the site, called 'Me at the zoo', was uploaded by Jawed Karim on April 23rd, 2005 and was used to test the site. In May that year, the website launched as a beta and was soon

racking up 30,000 visitors a day. By today's standards, that's tiny but back then, this was big news for a startup website. That figure soon rose exponentially, and by the time YouTube launched officially in December 2005, it was getting two million video views each day.

Some of YouTube's launch features are still fundamental parts of the website today. Video uploading and hosting, subscriptions, playlists, ratings, and full-screen mode were all available back then. Broadcasting content to the world gave everyone with a camera and a computer the chance to be a filmmaker and allowed people to become invested in the site.

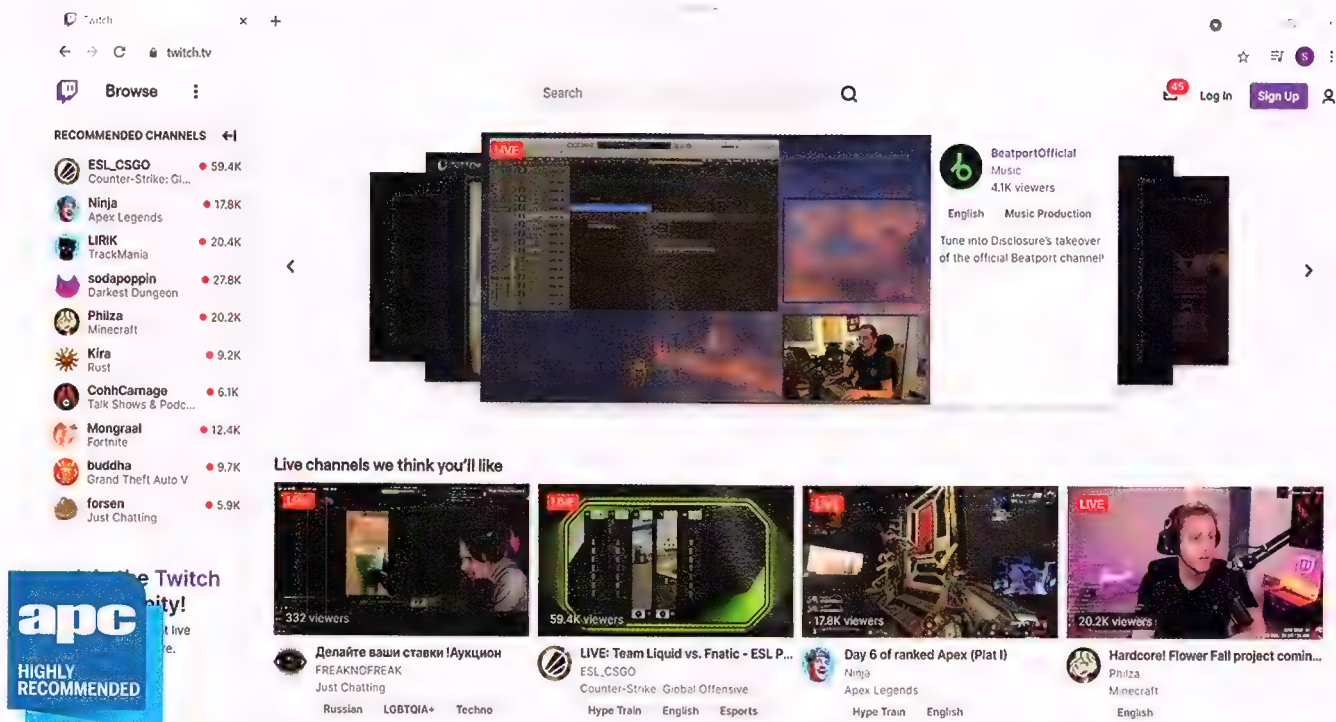
By mid-2006, YouTube hit over 20 million monthly visitors, making it one of the fastest-growing sites on the internet. The technical demands of running a site this large meant more and more equipment and broadband connectivity were needed. On top of this, some of the content uploaded broke copyright laws. The owners looked to sell up and managed to hook a large buyer. On October 9th, 2006, Google bought YouTube for the tasty sum of US\$1.6 billion.

The purchase brought security to the

site and saw some big changes, one of the biggest of which was the introduction of adverts. As annoying as they were (and still are), ads meant that creators could earn money from the site. Without this, YouTube and internet video consumption would be a completely different experience today. It's fair to say YouTube has changed not only the internet but also the wider entertainment and media industries too. Competitors such as Twitch probably wouldn't exist if it weren't for YouTube.

Though both are video streaming sites, they differ in terms of their content. Essentially, Twitch is YouTube but with live videos. Twitch began in 2007 when creator Justin Kan made a rig from a webcam strapped to a hat and a laptop in a backpack. He started live-streaming his life 24/7 on March 19th, 2007 and this live stream grew in popularity until, with the help of fellow computer programmers Emmett Shear, Michael Seibel, and Kyle Vogt, it became a channel, called *Justin.tv*.

This video site was purely for people to upload live content, essentially the internet version of TV. Gaming was a big driver of traffic from the start and though the site branched out into areas such as sports and music, copyright



issues with illegally uploaded content meant that those areas had to be restricted. Gaming remained at the core of the site and eventually, in 2011, Justin.tv was relaunched as Twitch.

Over the years, both platforms have had countless updates and alterations but the formulas have remained the same. Though the two sites are similar, they are different enough to have co-existed for the past decade. YouTube is for content that has been planned out and created, which makes it a great place to let your creativity flow and to build an audience through editing and content.

Twitch is more of a place where the creators' characters shine and where they can express their personalities. While both sites offer similar content, watching something live on Twitch gives it a greater sense of anticipation than you get from a YouTube video. In 2017, YouTube attempted to muscle in on Twitch's USP by launching its own section for live streaming.

As far as design goes, YouTube certainly paved the way for the sites that followed. YouTube's site formula hasn't altered too much over the years and it remains easy to use. On the opening page, at the top, there is a search bar, the main part has suggested videos or channels you are subscribed to. On the left is a tab where you will find the home, explore, subscriptions, library, history, watch later, and liked videos sections. As a Google product, it is clean and easy to navigate around.

Unfortunately, the same cannot be said for Twitch. It's not exactly ugly, but

Though both are video streaming sites, they differ in terms of their content. Essentially, Twitch is YouTube but with live videos.

it does look a little messy, particularly for the first-time user. On the left side of the website are your subscriptions and suggested followers. The main section of the site has a carousel with live streams, below that are your followed channels and categories. This is in view order and although it's a great way to see what is trending, it can get a bit crowded. Overall, YouTube is the better-designed site of the two.

But what about features? Since YouTube introduced a live streaming section, it has been a direct rival to Twitch. However, as a platform, YouTube doesn't prioritise streaming and its main focus is still non-live creator content. Twitch, on the other hand, is purely for live content and that remains its unique selling point.

YouTube is a more professional feeling platform with a much larger audience, but live streaming is better on Twitch. The communities built on the site are close to the creator and the interaction with your audience helps Twitch to be the best place to stream. Live streaming content on YouTube can feel lost and out of place.

The principles remain the same – if you want to watch videos, go to YouTube and if you want to watch live streams, go to Twitch. Even though YouTube has more features and is a more professional environment, YouTube's streaming

section has yet to really challenge Twitch.

Overall, both sites have been a huge and vital part of the progression of the internet, with absolutely enormous catalogs of unique videos and billions of viewers, it's hard not to say that this new age of media consumption is gradually taking over.

YouTube takes the crown ahead of Twitch though. It is one of the biggest sites on the internet, it paved the way for video sites, and made a whole industry for creators to make money online. Although Twitch has followed a similar path and added live content to its platform, YouTube's extra features and better website design keep it ahead of its rival.

YouTube

Lots of great features, has changed video consumption, great for creators, though the live streaming aspect of the site isn't fully developed.

★★★★★

Twitch

Revolutionised live streaming and the industry, highly interactive. Slightly overwhelming design, focuses on live.

Sam Lewis

★★★★★

iOS APPS

iOS 10 OR LATER | \$74.99/year (Personal plan) | onmail.com

OnMail – Fast & Simple Email

Sending out mixed messages.

OnMail's app is billed as 'email built for today'. It comes with a host of thoughtful features but it really needs a little refinement going forward.

Starting on the inbox view, you will find a few neat tricks. Swiping from left to right on a message gives the usual options to mark it as unread or trash it. Swipe the other way, though, and you can move it to the Done folder, which is a repository for mail you have dealt with but do not want to delete. It's a great way to keep your inbox tidy without viciously purging it. There are other nifty inbox features too. You can approve unknown senders before their messages enter your inbox. Attachments are popped out below their associated emails. Tracking pixels are automatically removed. However, there is no way to add flags or starred indicators, which feels like an oversight to us.

Most of the key tools you need are housed in a swipe-up tab at the bottom of the app. Swipe up on your inbox and you can search your mail in natural language. You can also jump to various standard folders or OnMail's AI-powered 'smart folders'. These contain travel documents, parcel tracking details, and more. Leave the tab down and you can switch between your Primary inbox view and any others you have added (annoyingly, right now you can only add new sections from OnMail's web app, not its iOS app).

Tap the Other button on the tab and you get a taste of Preview Mode, which samples newsletters and promotional emails in a feed. It is a

great way to quickly browse messages, but OnMail misses a trick by not letting you swipe to deal with them. It slows down what is meant to be a quick viewing mode. The swipe-up tab is also visible when you view an individual email. Here, you can reply, mark the message as done or unread, or access more actions like moving the message to spam from the three-dot menu. Swipe up and OnMail shows the email thread's participants; tap one and you see their profile, along with any attachments and messages they have sent.

Sending emails is easy and fuss-free. Backing out halfway through composing does not prompt to save the message to drafts but it should save. However, we encountered a bug where our drafts

only appeared in the web app, not in the iOS app.

OnMail is totally ad-free. We reviewed the Personal plan for \$74.99 per year, which has extra storage, the ability to password protect files, and support for custom domains. Frustratingly, importing third-party accounts is also locked behind this paywall, which we feel should be a free feature.

OnMail is a promising email app with some great features. It needs a little tweaking, but its main issue is that you have to pay to bring existing inboxes with you.

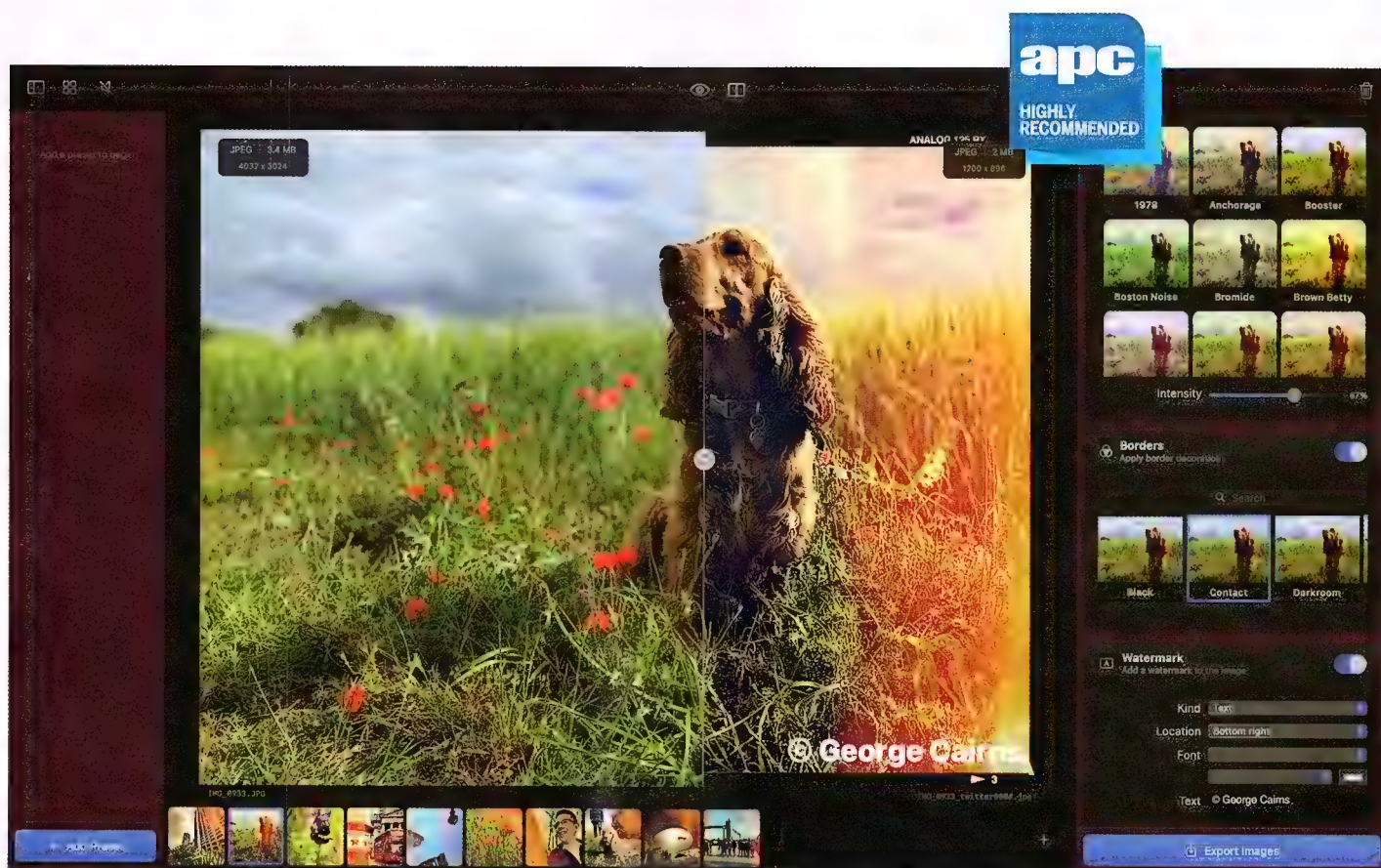
Full of great ideas but could do with a little fine-tuning. **Alex Blake**

★★★★☆



OnMail's inbox organisation is great, but individual messages aren't quite as strong.

Most of the key tools you need are housed in a swipe-up tab at the bottom of the app. Swipe up on your inbox and you can search your mail in natural language. You can also jump to various standard folders or OnMail's AI-powered 'smart folders'. These contain travel documents, parcel tracking details, and more.



MAC STORE & OTHER MAC APPS | macOS 10.14 or later | \$22.99 | realmacsoftware.com

Squash 3.0

Batch resize, filter, and convert a range of file formats.

Squash is a batch image processor that has a range of tricks up its sleeve. For starters, it can take any file formats that you throw at it and quickly convert them into easily shareable JPEG files. This is especially useful if you capture images on an iPhone as HEIF (High Efficiency Image Format) files or larger DNG (Digital negative) files shot in Apple ProRAW.

While an HEIF file takes up less space (around 1MB) it is not as useful as a JPEG file that can be shared via email or uploaded to social media platforms. DNG files can weigh in at 25MB so are too large to be sent via email. They also need to be converted to JPEG format before they can be viewed online. Fortunately, Squash can

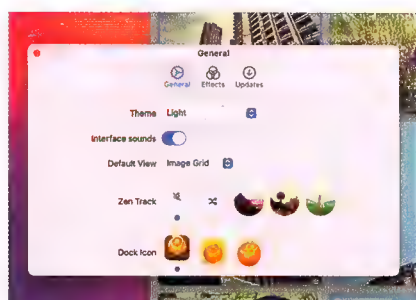
take any file format (including Camera RAW files from DSLR cameras) and convert them into the more compatible JPEG format. You can also convert a batch of images into other formats such as PNG or a high quality TIFF.

You can change Squash's preferences from the default Grid view to Editor. This enables you to swipe across the image to see a before and after version. The Preferences menu also gives you the option to turn on a Zen Track, which provides a series of ambient soundtracks to accompany your batch processing. Squash has a slick-looking interface that can be set to a light or dark theme. We found that the dark version makes the app look more like other image-editing apps, such as Photoshop.

As well as converting files from one format into another, you can batch edit a wide range of properties. Simply drag and drop a collection of files into Squash and then modify a series of panels to process the files. For example, if you plan to share images on Twitter you can use the Resize panel to set them all to a Twitter-friendly width of 1,200 pixels. The Adjustments panel lets you batch sharpen shots and boost their vibrance to give them more impact in your social media feed.

Although you can't directly adjust image properties such as contrast or exposure, a collection of one-click effect filters enable you to creatively process your shots' colours and tones to produce eye-catching looks. You can purchase extra filter packs to expand Squash's creative capabilities, such as adding retro camera 'light leakage' effects to your images. You can further enhance the retro filtered look by adding borders, from the traditional white photo frame to a contact-sheet style edge.

Once you share shots online, you can lose control over where they end up. Squash enables you to add a personalised watermark to every image (such as a Twitter handle or a copyright notice). To protect the privacy of people in the shots, you can toggle a switch to remove embedded metadata such as the GPS coordinates of an image's location. Squash will also batch-rename your files while it creatively processes and resizes them once you click the Export Images button.



Convert a host of file formats into web-friendly lightweight JPEGs.

Reduces the time-consuming chore of batch processing images in an easy-to-use workspace. **George Cairns**

★★★★★

Android | Free with IAP

Tuned

Couple's therapy.

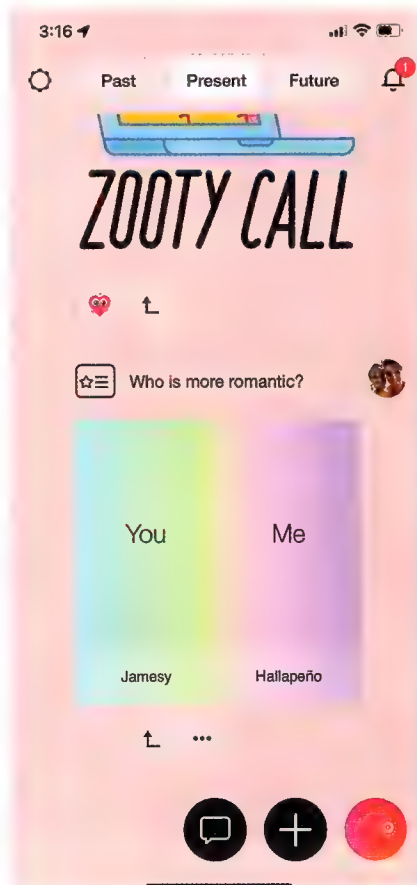
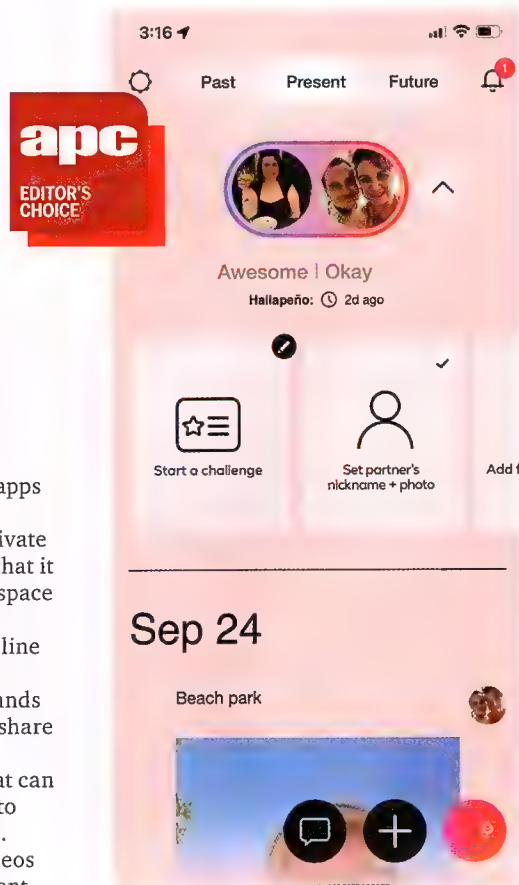
Back in the early days of mobile apps there was a couples app called Avocado – it was a fairly basic private messenger, but the essence was that it was a confidential and enclosed space for you and your partner to talk without the noise of the other online social media environments.

Tuned takes this idea and expands on it, creating a private space to share your current moods and ideas, feelings, and special prompts that can range from fun little challenges to more serious and deep questions.

You can send gifs, stickers, videos and pictures. In a fun little element – only you can change your partner's information, like their profile photo and nickname. You can post songs you are listening to with Spotify or Apple Music integration and create lists.

My wife and I have really enjoyed using this app to carve out a little personal space for working on our own relationship. The fun challenges have been the best part – we ended up having a fun little discussion about why we chose our favourite three Ninja Turtles and the order in which they were ranked.

Additionally, the app is entirely free, and there are no ads or in app purchases at all. I was curious why this was, especially as the app is very well designed, fluid, and fast.



The fun challenges have been the best part – we ended up having a fun little discussion about why we chose our favourite three Ninja Turtles and the order in which they were ranked.

I didn't recognise the developer's name as it seemed ambiguous. Some quick investigation found that this app is, somewhat sneakily, made by Facebook via their "NPE Team" (New Product Experience), which is essentially an avenue to experiment with new products without the hangover of their trouble brand names. Thankfully, a Facebook account isn't required, and it doesn't

seem to link to any of their other apps.

However, their terms for products made under this brand notes that these "experimental apps" may be removed at any time if they are not popular or well utilised. There is also a possibility that it may be merged into Facebook or require a login in the future, so buyer beware.

★★★★★

Android | Free with IAP

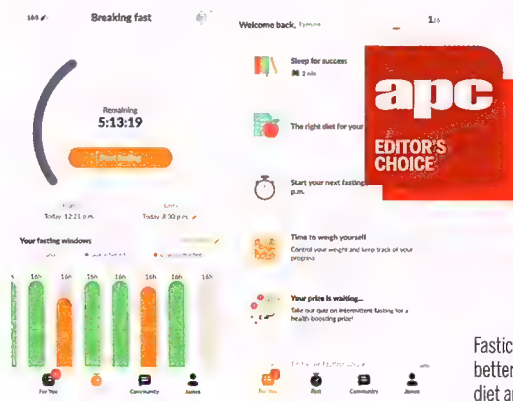
FASTIC Intermittent help.

Diets are generally fraught with drama but as someone who is a big fan of intermittent fasting, I had found it difficult to keep to the schedule and timeframes involved. Fastic is a great resource for this relatively simple task – providing both a timer as well as a great guide as to how your body is reacting and processing during the time you are fasting.

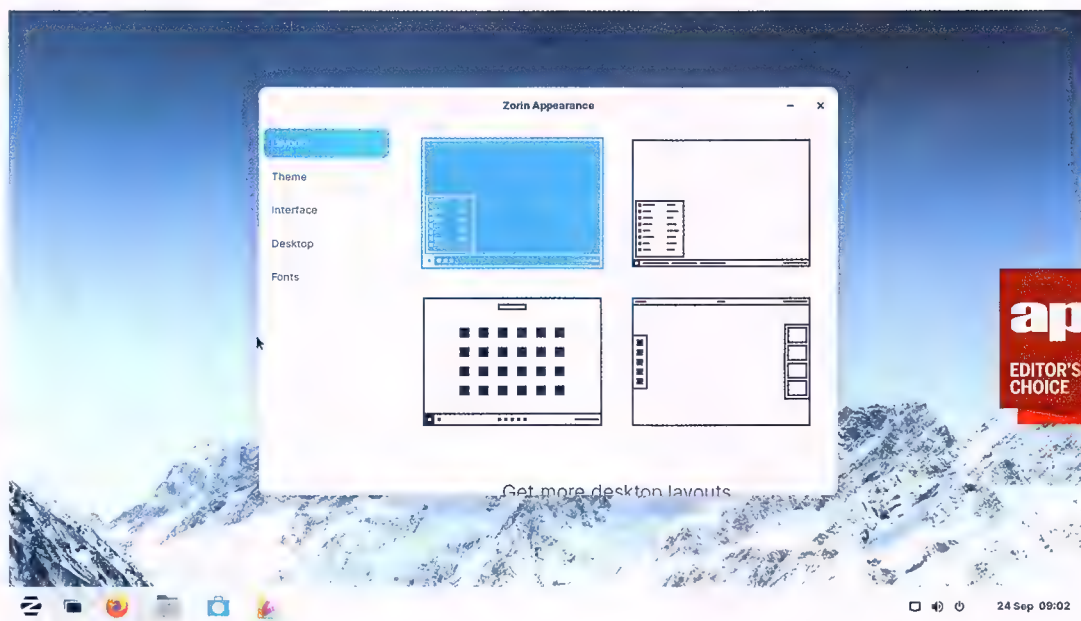
Additionally, it also "rewards" successful fasting sessions with stars that allow you to 'buy' skip days when you're needing a break or just want to have a cheat day or weekend. There's also a host of information and guides on healthy eating, exercise, hydration and such provided by doctors and nutritionists.

There's also a Fastic Plus subscription that offers more custom plans, tailored nutrition, habits and expert advice. Thankfully this is entirely optional and the free version of the app provides the basics. JAMES PINNELL

★★★★★



Fastic is one of the better fasting-based diet apps.



Pick a desktop, any desktop! Zorin Appearance makes it easy to have your desktop emulate the look of a different OS.



CPU: 1GHz 64-bit
Memory: 2GB
HDD: 15GB Core, 30GB Pro
Build: x86 64-bit only

Linux | zorin.com/os

Zorin OS 16 Core

A way to move operating systems, or a desktop with an identity crisis?
 Neil Bothwick pretends to be a Windows lover while he tries Zorin OS.

There are several Linux distributions that aim to provide an easy introduction to Linux for those coming from Windows. They may do this by providing a Windows-like appearance, or go deeper. Zorin OS falls into the latter category. It's available in three versions: Core, Lite and Pro. Core, the version we have here, is a free distribution, in both senses of the word. Lite is a lightweight version designed for older computers and available in 32-bit as well as 64-bit flavours. The Pro version is a paid product, currently costing \$39.

Zorin OS is based on Ubuntu, which is clear when you run the installer. It follows the same process as the standard Ubuntu installer, even though it looks different. The same is true of the Zorin Gnome desktop – it has its own look, a clean one that I found very pleasant to work with. In fact, there are several desktop appearances to choose from; you switch between them by selecting Zorin Appearance from the main menu.

These choices give a clue to Zorin's target audience, those coming from Windows or macOS. It is not that the desktop layouts try to emulate those

other operating systems, but they do provide a more familiar introduction, or you can go for the standard Gnome shell layout as used by Ubuntu. There are further layouts available with the Pro edition, along with extra software. However, we didn't have access to a Pro version and the website is quite vague about the extras.

Zorin tries to handle the needs of Windows users as best it can, including being able to install (some) Windows programs. When you run a Windows EXE installer, it offers to install it via "Windows App Support". Unfortunately, the installation of that software then fails with a cryptic message about unmet dependencies. Installing Windows App Support from the software manager worked though, although this is not something a first-time Linux user would be expected to know.

Windows app support is basically Wine and PlayOnLinux, packaged so that Zorin can run Windows apps whenever possible. It is a good idea to help Windows users start with Linux without having to abandon all the software they know, but it needs some work. One nice

touch is that if you try to install something for which a native Linux version exists, such as Thunderbird, Zorin will offer to install it from the Software Manager. Another addition to the standard Ubuntu fare is Zorin Connect, a way of keeping your computer and Android device in sync, including displaying notifications, controlling music playback and even using your phone as a slideshow remote.

When a distro is aimed at new Linux users, effective hand-holding and documentation is important. The website contains some guides; one on installing Zorin and an excellent, comprehensive guide on installing software from various sources. The latter is important as this is an area that confuses those coming from Windows. It is just a pity that there is not more documentation, especially as the quality of what is there is so high.

Because it is based on Ubuntu, and can run in a Windows-like desktop or more vanilla Gnome, Zorin OS is not only for beginners. It is a distro that new users can start with, but they can also grow with, getting rid of the Windows theme when it is time to remove the training wheels.

Windows app support is basically Wine and PlayOnLinux, packaged so that Zorin can run Windows apps whenever possible. It is a good idea to help Windows users start with Linux without having to abandon all the software they know, but it needs some work.

Zorin makes a good job of easing the transition to Linux. The Wine feature needs some work, but Wine is an imperfect solution anyway.

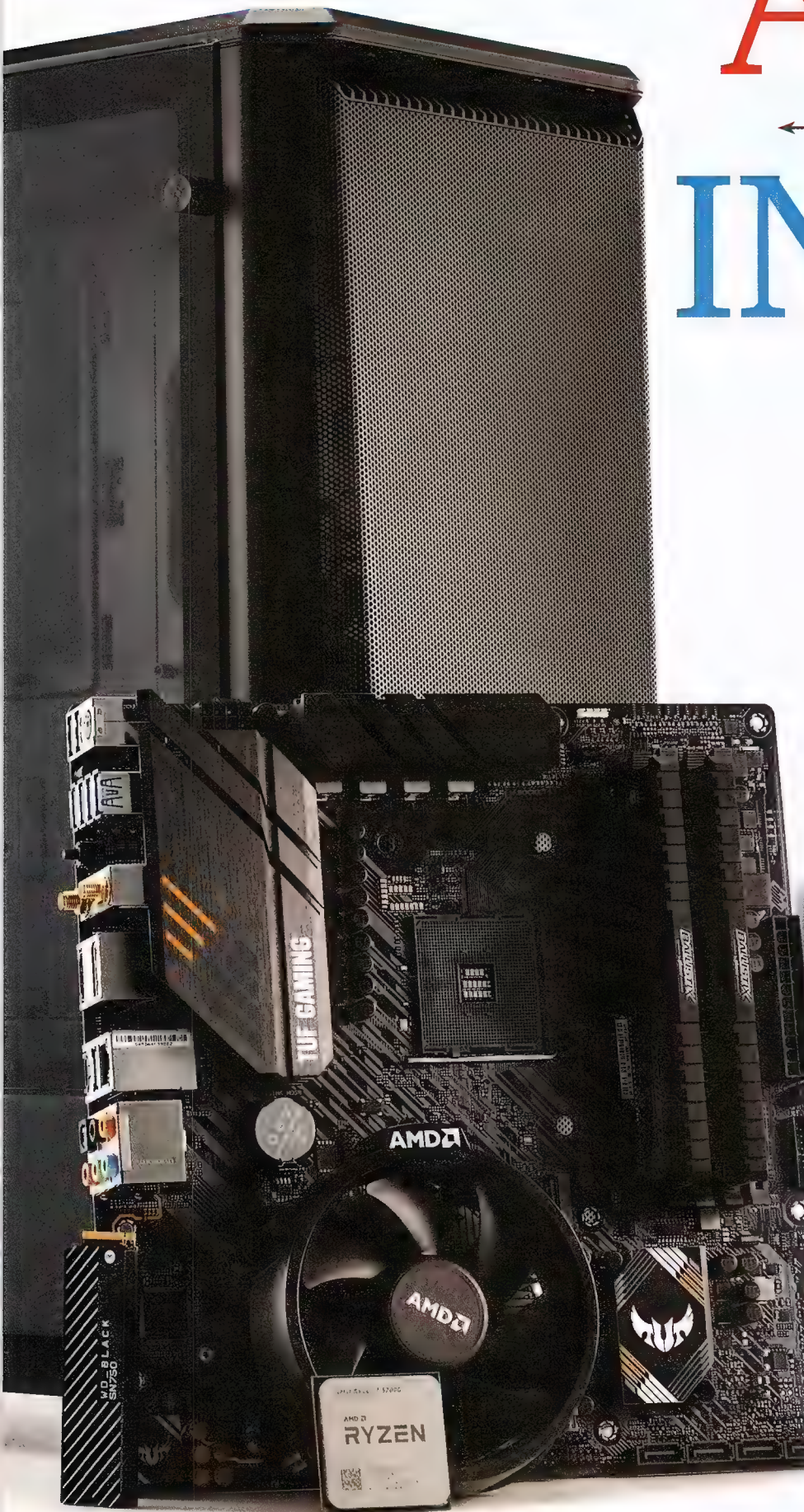
★★★★★

AMD ← VS → INTEL

PC gaming, right now, is at a standstill. The computing world has been rocked twice – once by the pandemic, and then again by cryptocurrency. Our humble GPUs have been snapped up and thrown into the deep, dark abyss of crypto mining, toiling away on inane calculations generating value from nothing. Whatever your stance on cryptocurrency, whether you believe it's the future of decentralised finance or a meritless environmental disaster, it's impossible to deny the impact it has had on the industry. As the availability of new GPUs has dwindled, enjoying our humble pastime is all but impossible. This generation's mid-range graphics cards are now priced like last year's flagships. Budget options are coming in at \$800, and the whole market, although slowly recovering, is still a place of desolation

AMD INGREDIENTS

PART		Price
CPU	AMD Ryzen 7 5700G	\$520
COOLER	AMD Wraith Stealth Cooler	\$0
MOTHERBOARD	Asus TUF Gaming B550M-Plus (WiFi)	\$220
MEMORY	16GB (2x8GB) Crucial Ballistix @ 3600 CL16	\$130
STORAGE	1TB Western Digital Black SN750 PCIe 3.0 M.2 SSD	\$180
POWER SUPPLY	450W Corsair CV450 80+ Bronze	\$60
CASE	Phanteks Eclipse P400A	\$110
TOTAL		\$1,220



Two budget PCs go head-to-head in an epic integrated graphics PC build-off.

when it comes to sourcing that most vital of PC components.

So where do you turn, when the GPU's time in the sun is currently stifled? To integrated graphics? Given that processors are currently one of the few areas cryptocurrency can't make a quick buck, it's not a bad shout. For years, we've championed integrated graphics as "just enough" for entry-level 1080p gaming, but as GPUs became more affordable, development in iGPUs stagnated, until now.

With AMD launching its Ryzen G series chips, and Intel declaring its 11th-generation processors packed some of the best graphics performance Team Blue has ever mustered, we decided it was time to put the two to the test by building two similar rigs to truly decide who holds the crown of this generation's iGPU king.

INTEL INGREDIENTS

PART		Price
CPU	Intel Core i5-11600K	\$420
COOLER	be quiet! Dark Rock TF 2	\$120
MOTHERBOARD	MSI MAG B560M Mortar WiFi	\$220
MEMORY	16GB (2x8GB) Corsair Vengeance LPX @ 3200 CL16	\$100
STORAGE	1TB Western Digital Black SN850 PCIe 4.0 M.2 SSD	\$280
POWER SUPPLY	500W be quiet! System Power 9 CM 80+ Bronze	\$80
CASE	Corsair iCUE 220T RGB Airflow	\$130
TOTAL		\$1,350



AMD Ingredients



CPU Cooler - \$0

AMD WRAITH STEALTH COOLER

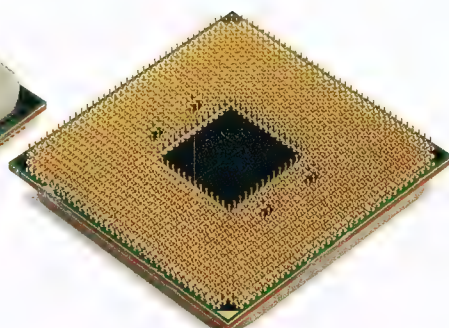
There's nothing we love more than a good deal at APC, and a free cooler is right up our street for this build, especially given the price of the Ryzen 7 5700G. As standard, it comes with the impressively robust Wraith Stealth cooler. This meaty offering packs a serious punch and makes Intel's old and outdated included heatsink look like a paperweight in comparison. You install this little guy by removing the brackets from the motherboard and using the included mobo backplate to screw it into position. It's not quite as fancy as the be quiet! cooler offered up by the Intel rig, but it's free! www.amd.com



Processor - \$520

AMD RYZEN 7 5700G

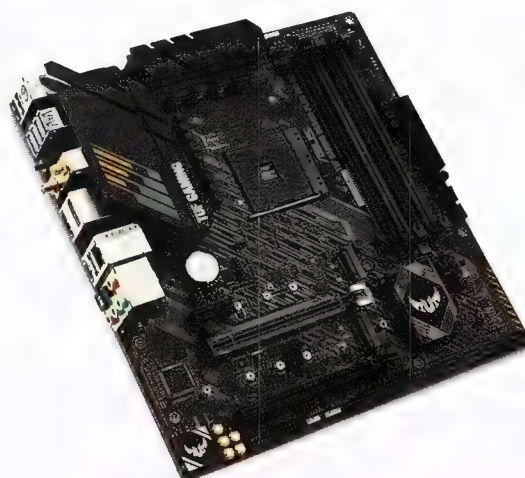
The main talking point of this build is the AMD integrated graphics chip, specifically the AMD Ryzen 7 5700G CPU. This chip marks the arrival of the 7nm Cezanne Zen 3 APUs. This 65W CPU is packed with eight cores and 16 threads, a 3.8GHz base and a 4.6GHz boost clock, 16MB of L3 cache, and eight Radeon RX Vega CUs that operate at 2.0GHz. It looks pretty tasty on paper, it's a Zen3 chip too so it steps up to a DDR4-3200 interface from DDR4-2933. This will certainly aid gaming performance with the integrated 7nm Radeon RX Vega graphics engine. It should produce solid 1080p gaming and for our battle, that's exactly what we are aiming for. www.amd.com



PSU - \$60

450W CORSAIR CV450 80+ BRONZE

We have gone for a budget-priced PSU in this build, which is more than capable of powering our machine. With no traditional radiator AIO and no GPUs, we don't necessarily need a huge powerhouse PSU. It's a non-modular power supply, which does hinder cable management a bit. Ideally you want to remove cables you're not using (such as any PCIe power and of course those excess SATA cables that are going to take up space in the bottom half of the case). Another downside is if a cable gets damaged, replacing it may be a pain in the backside. Sure, the 80+ bronze efficiency rating isn't what we would have in a more premium build, but at such a budget price tag, we can't complain. www.corsair.com



Motherboard - \$220

ASUS TUF GAMING B550M-PLUS (WI-FI)

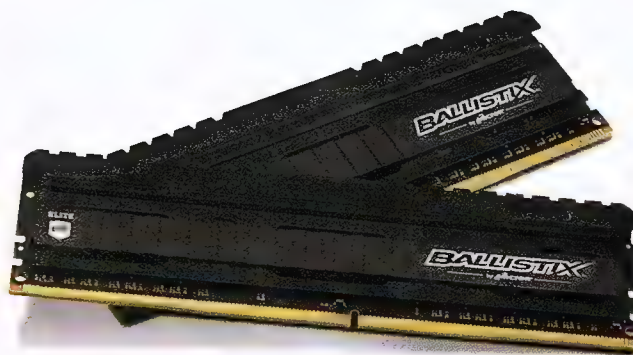
There are plenty of motherboards to choose from, but Asus boards have worked well for us before and this TUF Gaming B550M-Plus Micro-ATX is a solid pick. It has upgraded power delivery and comprehensive cooling options to fuel the latest AMD Ryzen CPUs. With BIOS FLBK support, it is easy to set up and install too. The socket for this board is the AMD AM4 socket, making it ready for 3rd Gen AMD Ryzen processors and 3rd Gen AMD Ryzen with Radeon graphics processors. It also has next-gen connectivity with PCIe 4.0 M.2, USB 3.2 Gen 2 Type-A, Type-C, and Wi-Fi 6 support. This should go well with our AMD Ryzen 7 5700G. www.asus.com



Storage - \$180

1TB WESTERN DIGITAL BLACK SN750 PCI-E 3.0 M.2 SSD

This Western Digital SN750 is a sleek SSD with a design that accommodates most PC builds and the heatsink fits in nicely with our motherboard. It should cut game load times, improve overall performance and allow for a solid 1080p experience. It doubles storage density from the last generation with NAND technology. The SSD also is great when using the WD_BLACK SSD Dashboard, as it allows you to optimise performance with the gaming mode. It disables low power mode on the SSD and makes sure it is running at full power. With sequential read speeds of 3,470MB/s and sequential write speeds of 3,000MB/s, it's no slouch. www.westerndigital.com



Memory - \$130

16GB (2X8GB) CRUCIAL BALLISTIX @ 3600 CL16

There is always an abundance of RAM sticks to choose from when building a PC. RAM speed was our main priority, as this matters more for AMD CPUs than Intel chips. AMD CPUs have a cut-off speed of 3733MHz, so ideally we would have had some of those in this build. However, these Crucial Ballistix DDR4 sticks run @3600MHz. 16GB is a good amount, but this can always be increased, the price swayed us – under \$150 is good for sticks of this speed. It isn't the most interesting choice, but we weren't going for a specific aesthetic. RGB is always an option, but if you want to tone things down a little, this all-black Crucial Ballistix memory kit is a good choice. www.crucial.com



Case - \$110

PHANTEKS ECLIPSE P400A

This all-black ATX mid-tower case from Phanteks is a great choice for this build and a majority of other builds too. With an angular mesh front panel, the case looks sharp and strong with plenty of intake airflow. The front I/O contains two USB 3.0 ports, a mic and headphone jack, a reset button, and a three-speed fan controller. With the great airflow and fan controller built-in, you can tell this case has been made with airflow in mind.

It comes with two 120mm fans with enough room for six 120mm fans if you need them or you want your PC to take off. It supports ATX, Micro-ATX, Mini-ITX, and E-ATX so it's pretty darn compatible. Paired with some great cable management, there's not much we can say that is wrong with this case.

www.phanteks.com

Intel Ingredients



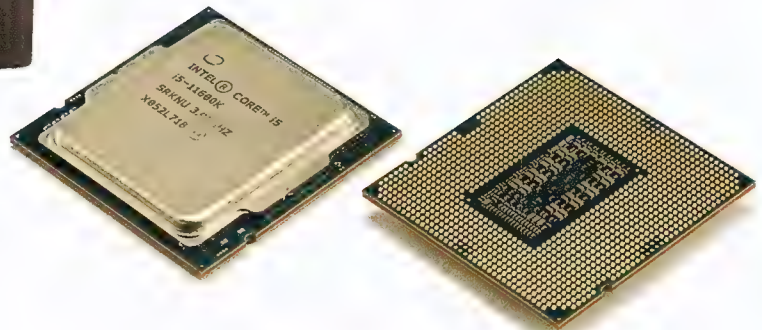
CPU Cooler - \$80

BE QUIET! DARK ROCK TF 2

Unlike our competition over on Team AMD, the Core i5-11600K doesn't come with its own cooler. So, we've chosen the Be Quiet! Dark Rock TF 2. With a super sleek design, twin fan construction, and epic six heat-pipe design, this twin pseudo-low-profile CPU cooler can chill any chip capable of running at near 230W of TDP, and at an impressively quiet 27.1dB(A). If you can't get the Dark Rock, the Be Quiet! Shadow Rock TF 2 is also a good choice.

Each manufacturer measures TDP differently, but this thing is more than capable of cooling even the Core i9-11900K. It also packs in a three-year warranty, and the fans even have a rated lifespan of 300,000 hours at 25C.

www.bequiet.com



Processor - \$420

INTEL CORE I5-11600K

An APC regular, the Core i5-11600K is perhaps the best of Intel's latest generation of processors. Featuring six cores, 12 threads, 12MB of cache, and a turbo clock speed of up to 4.9GHz, it's a 95W 14nm monster based on the Rocket Lake architecture. Other headline features include PCIe 4.0, but we're most interested in the integrated graphics. The 11600K delivers Intel's latest UHD Graphics 750 config, with a max dynamic frequency of 1.3GHz, 32 Execution units, and the ability to drive displays up to 5120 x 3200 @ 60 Hz. It also has support for DirectX 12, OpenGL 4.5, and a number of interwoven Intel GPU features too. But is it enough to beat the competition? www.intel.com



PSU - \$80

500W BE QUIET! SYSTEM POWER 9 CM 80+

We'll say this until we're blue in the face – but get a decent power supply. You don't have to spend a lot, just buy from a brand you trust, even if it has an 80+ rating, and is non-modular. There are so many dodgy PSUs with subpar components out there that could take your system out, it's not worth the risk. Take our faulty RGB controller tripping the entire build. It shot the power supply instantly, but the rest of the rig, the motherboard, the CPU, were all fine – protected by some ingenious engineering from this German manufacturer. The System Power 9 CM is a fine little unit, with plenty of cables, and modular too. At 500W, it's got plenty of headroom for our system, and will even support an RTX 3080 (if they're ever in stock again).

Oh, and it's... quiet. www.bequiet.com



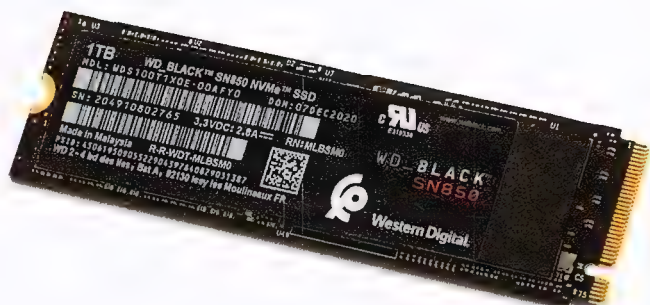
Motherboard - \$220

MSI MAG B560M MORTAR WIFI

Magnificent? Magnum? Magnetic? MSI hasn't told us what "MAG" stands for in its latest line of motherboards, but this is the board that we picked to house our plucky little chip.

Complete with a sleek aesthetic and plenty of connectivity, the B560M Mortar comes highly recommended, and packs in exactly what we need, including a PCIe 4.0 slot for our M.2 of choice, a ton of onboard connectivity, including Wi-Fi 6E and a 2.5G LAN port, and lastly both an HDMI and DisplayPort to go with that integrated GPU. On top of that, we can pop a GPU (when they're available) in the topmost PCIe slot and take advantage of that PCIe 4.0 x16 connectivity as well.

For a B series board at \$220, this thing is rammed with future-proofed goodness. www.msi.com



Storage - \$280

1TB WESTERN DIGITAL BLACK SN850 PCIe 4.0 M.2 SSD

So as we said earlier, our plucky little Core i5, supports PCIe 4.0 where the Ryzen 7 5700G does not. Advantage Intel. And we're going to take advantage of that advantage with this speedy little number from Western Digital. A counterpart to the SN750 featured in the AMD build above, the SN850 packs in 1TB of high-speed PCIe 4.0 NAND Flash goodness. Performance is better than you'll see in its predecessor PCIe 3.0 part. We're talking sequential read speeds of 7,000 MB/s and writes at 5,300 MB/s. For IOPS? 1 million 4KB Random Read and 720K Random Write – even the failure rate is impressive at 1.75M hours of use. What's not to love? www.westerndigital.com



Memory - \$100

16GB (2X8GB) CORSAIR VENGEANCE LPX @ 3200 CL16

So, the motherboard supports up to 5,066 MT/s memory, but let's be real, that stuff is still crazy expensive, and unless you're editing 8K video with a Core i9 (which, let's face it, you wouldn't be doing on a B550 board anyway), you won't need it. 16GB at 3200 will be more than enough for everything we need here, and better yet, the low-profile element of these sticks gives us plenty of clearance for the cooler too. www.corsair.com



Case - \$130

CORSAIR iCUE 220T RGB AIRFLOW

Last but by no means least, we have our case for this build, and that's the trusty Corsair iCUE 220T RGB Airflow. Now, it's getting a little long in the tooth at this stage, but as Corsair doesn't have a budget successor for it just yet, it's still perhaps one of the best (sort of) budget cases you can buy.

Perhaps unsurprisingly, the airflow with this chassis is impeccable. Even better than the Phanteks Eclipse P400A above. The reason behind it (aside from the triple fans), is that Corsair has expertly designed the front of the case with these triangular boomerang cutouts, instead of applying a mesh filter over the top. Contrary to popular belief, mesh filters actually impede airflow compared with a proper cutout. They create turbulence, and make it difficult for a fan to draw air through. Cutout panels like this one provide far larger gaps for that air to be drawn through, meaning lower temperatures inside your rig.

Aside from that, it comes with a set of three RGB 120mm fans as standard, and plenty of mod cons to make your building experience pretty seamless. And it's available in black or white finishes. The only downside?

We wish it had a fan controller as well as an RGB controller. www.corsair.com

Choosing benchmarks

The world of integrated GPUs isn't cut out for our usual suite of tests.

For most of our testing, we typically have a set list of benchmarks designed around being run on systems with dedicated GPUs. Most of the time, that involves running X game at Y resolution – usually on the highest graphical settings profile the game comes with as default. That way, it makes it easy for you at home to replicate those same tests with your own machine. It also gives you a better idea of how your rig scores in comparison and, of course, gives us a level playing field to work with when it comes to carrying out any similar testing in the future.

The problem with that is, in the world of integrated graphics, those kinds of benchmarks are grossly unfair to small integrated GPUs, such as the ones featured in these two builds. Yes, integrated graphics have come a long way over the years, and they are far from being stuck operating as media PCs and home office machines today, but throwing *Total War: Warhammer II* at an iGPU at 1080p Ultra is just cruel. Nor will it give us an accurate representation of how this chip would perform under more reasonable and realistic circumstances.

Total War is perhaps the best example of a CPU-intensive title from our testing suite. It's a game we choose specifically because it stresses the processor during regular benchmarking. In fact, most games (particularly single-player titles) generally leverage most, if not all, of the stress onto the GPU, rather than the CPU, or both. Strategy games, however, with

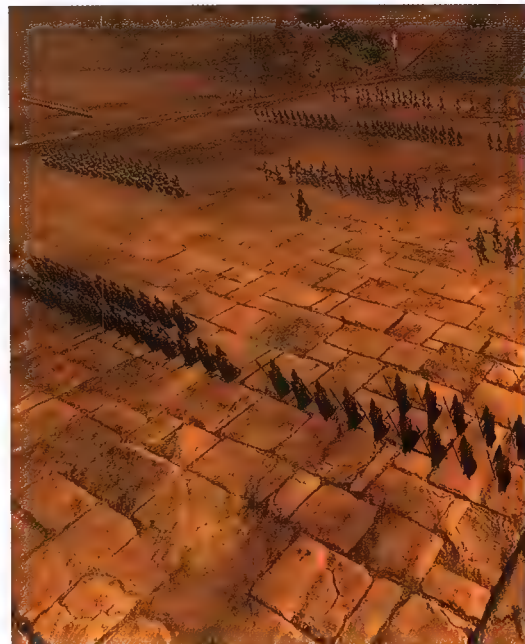
their many thousands of individual units, and some online games too, really do push processors hard.

Ultimately, you can have all the high-speed memory in the world, but it's just not going to be enough to manage *Total War* at 1080p Ultra on an iGPU, no matter what. And that's often reciprocated in our benchmark figures for builds like this. It's not unusual to see scores of 5 or 6fps in these tests on our usual platform and, obviously, that just won't do.

So, for this feature, we have decided to shake things up and do something a little different with the benchmarks. This time, we're going to be testing a selection of games at 1080p specifically, but across three separate presets instead, Low, Medium, and High, no Ultra in sight. The games are still challenging, and still comparable to the ones we regularly use in our usual suite, but it should give us a better indication of what you can expect from your iGPU PC. But we're not stopping there either! Oh no.

Gaming Performance

First up on the chopping block are the game benches. In this case, we're going to be testing *Total War: Warhammer II*, *Middle Earth: Shadow of War*, and *Assassins Creed: Valhalla* (all the colons) at 1080p low, medium, and high presets. This gives us a nice mix of titles to draw upon, including an older, neutral AAA game from 2017, in the form of *Shadow of*



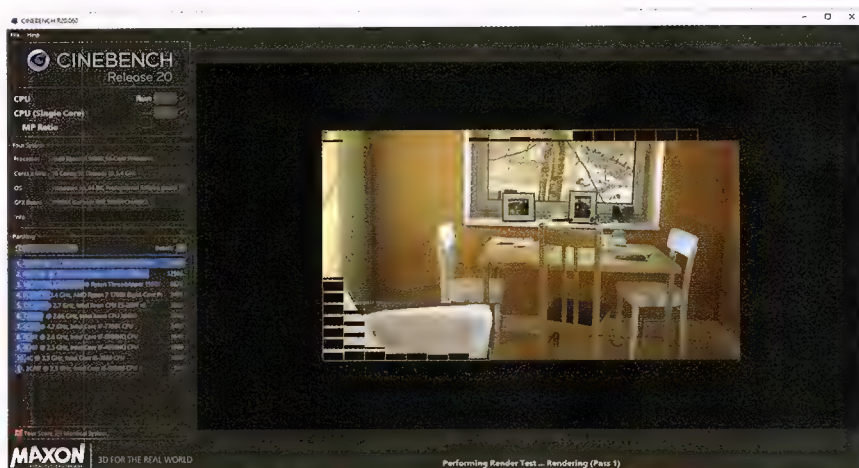
War, a brand new AMD-optimised AAA title in *Valhalla*, and an Intel optimised strategy game in the shape of *Total War*. All with included easy-to-run benchmarks.

On top of that, we're also going to be performing some more "old-school" synthetic tests, namely 3DMark's Fire Strike and Time Spy tests at 1080p. These will provide us with an index we can refer to, to see how far we've come from generation to generation, and also let us test performance both with DX11 (Fire Strike) and DX12 (Time Spy).

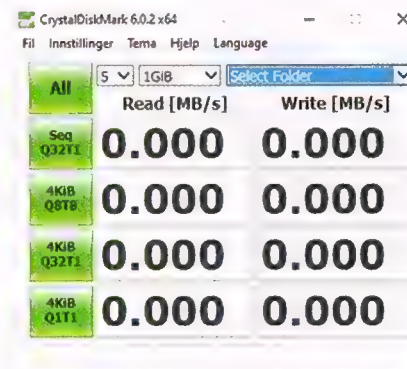
Computational Performance

With gaming out of the way, it's also important we take a quick look at the synthetic computational element of these two builds too. Both offer vastly different architectures and performance figures because of it. To do this, we've grabbed some basic, easy-to-run, synthetic tests

We have decided to shake things up and do something a little different with the benchmarks. This time, we're going to be testing a selection of games at 1080p specifically, but across three separate presets



CineBench is a staple rendering test that pushes your processor to the limit.



CrystalDisk shows how our SSDs perform.



that you can use yourself at home.

For processing performance, we'll be using CineBench R20 (you can download it yourself for free from here: tinyurl.com/APC501CB) to test out our processor performance, taking advantage of both its single-core and multi-core metrics. And finally, to test out our SSD performance, we'll also be taking a quick look at CrystalDiskMark 6 (tinyurl.com/APC501CDM). This should give us an accurate representation of how our two SSDs perform under pressure, namely looking at Sequential read/write speeds at a queue depth of 32, 1 thread, and also Random 4K read/write speeds at a queue depth of 1, 1 thread.

Sequential performance is indicative of reading or writing files that are stored close to one another on the drive itself (for instance, your photographs, videos, and media files, things like that), whereas Random 4K testing is more indicative of something like a game reading and writing to a variety of different locations on the drive at any one time. This is almost always more difficult to do than with sequential data, thus the far lower numbers in the tests.

As neither of these systems was really cut out to be video-rendering machines, workstations, or anything of the like, due to a lack of dedicated GPU, which massively accelerates these workloads, we're going to skip out on any memory testing or power-draw this time around.

So, ultimately, what we're left with is purely an exercise to see which integrated graphics solution is superior to the other.

Total War is perhaps the best example of a CPU-intensive title from our testing suite. It's a game we choose specifically because it stresses the processor during regular benchmarking.

FUTURE PROOFING PICKS

So, you've seen our two builds, looked at the parts, and wondered about the future.

After all, investing in a rig like this is usually going to future-proof you for the next five years, and with both AMD and Nvidia expecting silicon shortages to end from mid-2022, the chance of getting a graphics card at a reasonable price doesn't seem far away.

So, what happens if you add a GPU to either of these two systems? Traditionally, AMD's Ryzen G processors used to feature a reduced number of PCIe lanes for graphics. In fact, with the 3000 G series, it was half that of what you'd find on the non-APU equivalent or Intel's chips (x8 not x16 lanes). That meant most GPUs would be bottlenecked by a lack of bandwidth as the lanes just weren't there. x8 PCIe 3.0 lanes equates to around 8GB/s (or 64Gb/s or 4GT/s whatever takes your fancy) of maximum bandwidth, whereas x16 doubles that figure leading to a max of 16GB/s. The latest generation, PCIe 4.0, doubles those figures again, so you end up with a max bandwidth of 32GB/s across a x16 slot port, and so forth.

Now, we have yet to saturate the PCIe 3.0 x16 slot, 16GB/s is more than enough bandwidth to facilitate even the most high-end graphics card. That said, x8 lanes isn't, and you typically end up with a reduction in frame rate

of between 5-20 percent. Fortunately, AMD has redesigned its latest APUs to include x16 graphics PCIe lane support. It's still PCIe 3.0, but if you add a full-sized GPU, you shouldn't see any performance degradation, unlike what we saw back with the 3000 series. Good stuff.

The only concern is what AMD and Nvidia produce in terms of their next-gen GPUs, and how large the performance delta will be compared with the previous generation. We expect to see both the RTX 4000 series and RX 7000 series cards launch next year. AMD will likely have packed some dedicated hardware in for ray-tracing and Nvidia will be going harder than ever, due to the increased competition from the RX 6000 series.

It could be the year that we finally eke over that 16GB/s PCIe 3.0 x16 lane bandwidth limit, at which performance may begin to drop with our AMD Ryzen 7 5700G series processors (along with every other PCIe 3.0 chip, including Intel's 10 series parts too).

These things are hard to predict, and the performance difference may be less than 10 percent so it's a fairly negligible worry, but it's worth considering if you plan to invest in a GPU later on.



AMD conclusion

The results in this test weren't necessarily what we had hoped for.

But this is a test of the integrated graphics on each side of the battle, AMD and Intel. In an ideal world, we would accompany these CPUs with some hefty GPUs that would improve performance, but it's a test of iGPUs, not discrete GPUs.

On the AMD side of the head-to-head, the build itself was plain sailing to piece it all together, and yet the opposite once we tried to boot things up for the first time. With nothing but a blank display, we updated the BIOS (which was fairly easy as our Asus board has a BIOS FLBK port on its I/O) and then used a USB Windows 10 installer to get it ready for testing.

Once the machine powered on, we then installed the relevant drivers for the motherboard and the chipset to get the AMD APU up and running properly, or so we thought. After some initial

testing, our results weren't what we expected. Taking a peek at the memory using CPU-Z, it was clear the DDR4 was running at 2,666MT/s, not the 3,600 it's specced at. Jumping into the BIOS, we realised we'd forgotten to enable the XMP profile, so the speed and timings were out (rookie error!). To do that, we set the Ai Overclock Tuner profile to the DOCP option. This is AMD's alternative to XMP (eXtreme Memory Profile) usually found on Intel motherboards.

For AMD, with Asus motherboards, it's located inside of the Ai Tweaker menu. This should enable the XMP settings found on the RAM (increasing timings, frequency, and voltage in the process) and tell the motherboard to use the full speed the kit is capable of running at. RAM frequency matters to AMD chips, and for our PC to work at its best, it needs the full 3,600 MT/s that

our Crucial Ballistix RAM should be providing.

Unfortunately, after applying the DOCP profile, the machine kept rebooting and failing to post. So, we headed back to the BIOS and declocked the frequency down to 2,800 MT/s, to see if it would boot at a higher speed than the original stock settings outlined by JEDEC. Thankfully it did, but this was still an issue as we needed the memory speed to be working at its fastest. We kept restarting the PC and booting it up with a higher memory frequency each time to see what would stick but, unfortunately, the best we could get out of these sticks was 3,133 MT/s. It's not awful, but we didn't choose 3,600 MT/s sticks to underachieve like that, and these APUs love faster memory.

The only other memory we had spare were some 3,200MT/s G.Skill Trident Zs. Out of curiosity, we looked at whether we could get more performance out of these. Again we could only get a stable boot when configured to 3,000MT/s, so Crucial's offering still works better here.

Results were lackluster compared with what we're used to seeing from a discrete GPU, of course, but that's to be expected. After getting around 30fps on low presets on some games, our hopes for smooth 60fps, 1080p gameplay were dashed. The benchmark results speak for themselves. Ideally, you don't want to settle for a low preset, but anything less than 30fps isn't acceptable by today's PC gaming standards. SSD read and write speeds, however, were a high point of this build and for normal day-to-day usage, so while it works pretty well as a daily driver, it's not so good if you intend to do any high-end gaming.

Lacking a GPU and RAM sticks that run at their full potential hold this machine back from achieving a smooth Full HD gaming experience. If we had sticks that were fully compatible with our motherboard, we may be looking at a different outcome (reports even suggest up to 10-15 percent additional performance).

Still, the results were much higher than our Intel competition, and in older games or less graphically intense titles, such as *Minecraft*, *Hades*, or Roguelikes, it's an ideal PC to get your foot in the door. It just depends on what you play. Mainstream games, yes. AAA titles, no.

Results were lackluster compared with what we're used to seeing from a discrete GPU, of course, but that's to be expected. After getting around 30fps on low presets on some games, our hopes for smooth 60fps, 1080p gameplay were dashed.

SYNTHETIC TESTS

	Zero-Point	AMD build
CineBench R20 Single (Index)	572	576
CineBench R20 Multi (Index)	4.157	5.367
CrystalDisk QD32 Sequential Read (MB/s)	6,983	3,265
CrystalDisk QD32 Sequential Write (MB/s)	6,475	2,952
CrystalDisk QD1 Random 4K Read (MB/s)	31	46
CrystalDisk QD1 Random 4K Write (MB/s)	247	150
3DMark: Fire Strike DX11 (Index)	2,098	3,835
3DMark: Time Spy DX12 (Index)	792	1,547

GAMING TESTS

	Zero-Point	AMD build
Total War Warhammer II @ Low	20	34
Total War Warhammer II @ Medium	17	22
Total War Warhammer II @ High	14	25
Middle Earth: Shadow of War @ Low	15	28
Middle Earth: Shadow of War @ Medium	13	24
Middle Earth: Shadow of War @ High	9	19
Assassins Creed: Valhalla @ Low	12	23
Assassins Creed: Valhalla @ Medium	7	20
Assassins Creed: Valhalla @ High	5	17

Average frame rates reported for games. All tests were performed at 1080p on the indicated graphics preset. Zero point consists of an Intel Core i5-11600K, 16GB of DDR4 @ 3200, and a 1TB WD SN850 M.2 PCIe 4.0 SSD.

Intel conclusion

Future-proofing for an eventual graphics card upgrade.

What a ride this whole build process has been! If you skip the build guide starting on page 80, you can read about how our Intel build went “pop” during the photo shoot, taking out a power supply. We don’t know why, a fault somewhere along the line, maybe? But one fresh PSU later and we’re good to go.

Fortunately, unlike our Team Red competition, the Intel build’s install process went a lot smoother. As we don’t technically rely on high-speed memory in anywhere near the same capacity, what you get with this build is exactly what you get. Theoretically, we could add higher-speed memory, maybe go for a 3600 or 3733MT/s kit, but the only area we’d see performance increases would be in video-editing applications and maybe in Adobe Photoshop or similar programs. It’s not worth the extra investment unless you can find them cheaper due to greater availability (or a kit that doesn’t come with some flashy RGB).

You’ll notice I’m delaying talking about how the Intel rig did in terms of in-game performance. That’s because, if we were to sum it up in two words, it’d be “not good”. Not “not good” as in an “oh man, this system doesn’t have a discrete GPU, how terrible is the performance at 1080p” sort of way, but in an “oh man, this system can’t compete with AMD, despite costing more, and the performance is worse at 1080p” sort of way. Yeah, that kind of “not good”.

Our highest recorded average frame rate was 20fps in *Total War*, on Low at 1080p. The lowest figure was in an admittedly AMD-optimised title, *Assassins Creed: Valhalla* with a whopping 5fps on High. That’s not good. This is Intel’s latest UHD 750 graphics and it doesn’t hold a candle to that inside the Ryzen 7 5700G or even its cheaper sibling. This is a shame, because Intel’s Iris stuff is genuinely impressive, certainly on laptops. Perhaps it’s a limitation due to the size of the processor, or complexity due to architecture design (Intel still uses a monolithic chip design that’s costly and difficult to develop), but the lack of Iris graphics makes AMD the go-to choice for those looking to build a budget gaming PC.

The story gets better when you play some less intensive titles, such as *Hades*, *Minecraft*, and *Crusader Kings III*. All of them performed well,

SYNTHETIC TESTS

	Zero-Point	AMD build
CineBench R20 Single (Index)	576	572
CineBench R20 Multi (Index)	5,367	4,157
CrystalDisk QD32 Sequential Read (MB/s)	3,265	6,983
CrystalDisk QD32 Sequential Write (MB/s)	2,952	5,175
CrystalDisk QD1 Random 4K Read (MB/s)	46	81
CrystalDisk QD1 Random 4K Write (MB/s)	150	247
3DMark: Fire Strike DX11 (Index)	3,835	2,098
3DMark: Time Spy DX12 (Index)	1,547	792

GAMING TESTS

	Zero-Point	AMD build
Total War: Warhammer II @ Low	34	20
Total War: Warhammer II @ Medium	28	17
Total War: Warhammer II @ High	25	14
Middle Earth: Shadow of War @ Low	28	15
Middle Earth: Shadow of War @ Medium	24	13
Middle Earth: Shadow of War @ High	17	9
Assassins Creed: Valhalla @ Low	28	12
Assassins Creed: Valhalla @ Medium	22	7
Assassins Creed: Valhalla @ High	17	5

Average frame rates reported for games. All tests were performed at 1080p on the indicated graphics preset. Zero point consists of an AMD Ryzen 7 5700G, 16GB of DDR4 @ 3133, and a 1TB WD SN750 M.2 PCIe 3.0 SSD.

You’ll notice I’m delaying talking about how the Intel rig did in terms of in-game performance. That’s because, if we were to sum it up in two words, it’d be “not good”.

averaging 30-40fps, making them more than playable, even *Divinity: Original Sin 2*, and *Prison Architect* were enjoyable experiences. So maybe it’s not hitting that 60fps sweet spot, but you don’t need to play AAA titles to have fun, and both of these machines represent a significant leap over past generations in terms of that capacity. That said, with either build, you’d almost always be better off getting a dedicated GPU if you could right now.

Apart from that, the big winner for Intel was in the PCIe 4.0 performance. WD’s SN850 PCIe drive ran rings around its PCIe 3.0 predecessor, clocking in substantially higher scores, sequential reads were twice that of the SN750, and writes almost double, with a similar story on the Random 4K situation too.

So, then, AMD wins. For the time being, Intel can’t quite keep up, even

with an unlocked Core i5 and an advanced cooler on top of it. Admittedly, the 5700G is considerably more expensive than the i5, but even the 5600G clocks in similar performance (although with two fewer cores), and includes a cooler too.

If you want to run an iGPU system, don’t care about AAA titles, and are happy with that PCIe 3.0 limitation, Team Red is rightly king of the hill. However, if you’re looking for something to tide you over until you invest in a next-gen GPU, Intel still holds the iGPU candle there, at least for now. With both AMD and Intel ramping up to launch new processors, it may not be long until the battlefield shifts once more.

It’s a tale as old as time, Blue vs Red, Intel vs AMD – no doubt this battlefield will be revisited again soon, and that’s no bad thing, at least not for us.



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Windows 11 help, tips & tricks

Microsoft's big, new and free OS is out,
and here's how to get started.

Windows 11 is Microsoft's latest operating system, bringing a much more modern user interface across new and familiar elements alike. Announced at a dedicated Windows event in early 2021, Windows 11 launched in late 2021, and that means there are bound to be lots of problems, questions, and tips and tricks. That's where we come in.

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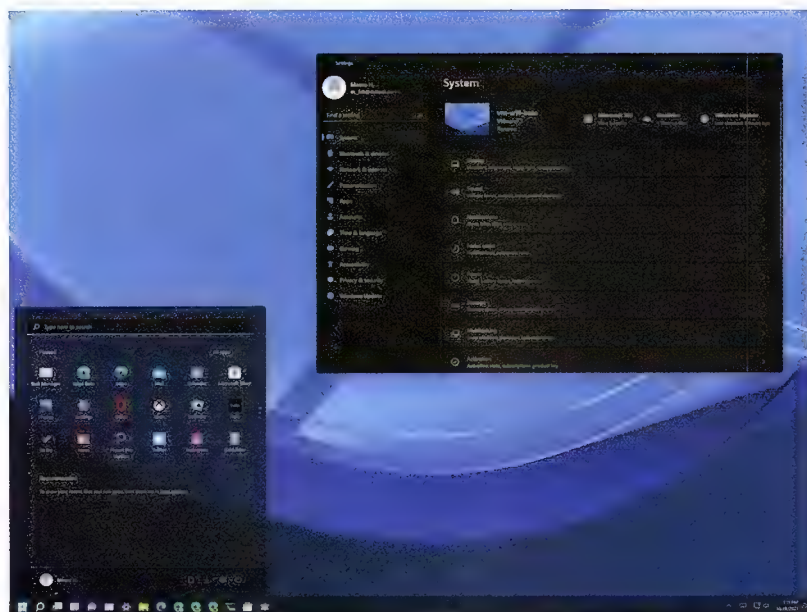
Configure
a VPN

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Gaming with
Windows 11



Getting started

How to install Windows 11, and what to do first.

Windows 11 is slowly rolling out as a free upgrade for eligible devices known to have a good upgrade experience through Windows Update. However, you can also get it manually using the Installation Assistant, Media Creation Tool, or the official ISO file.

A lot has changed. For example, Windows 11 now comes with a new interface that introduces a new simplified Start menu and redesigned Taskbar aligned to the center. Action Center is gone and replaced with Notification Center and Quick Settings, and the new “Widgets” feature will keep you informed with curated web content.

Microsoft is shipping a new version of File Explorer that ditches the ribbon-style menu. The new Settings app brings a new design and more possibilities to configure Windows 11. You will also find an overhauled Microsoft Store that includes more apps and better policies

for developers. If you are setting up a new installation or device, the new out-of-box experience brings a new friendly interface and more customisations options, and a lot more.

01 How do I install Windows 11?

Windows 11 is now available as a free optional upgrade for computers already running Windows 10 through the Windows Update settings. Of course, this is as long as the device meets the minimum system requirements, which includes having enabled TPM 2.0 and Secure Boot.

If you plan to install the new version of Windows, you can also perform an in-place upgrade with the new Installation Assistant tool.

Alternatively, you can mount the Windows 11 ISO file to File Explorer to launch the setup wizard to perform an in-place upgrade or clean installation.

You could also use the Media Creation Tool in the past, but the tool has been updated only to provide the functionality to create installation media.

You can also start with a fresh clean installation, which involves erasing the drive with the previous setup, and installing Windows 11 from scratch. This process takes a little more time and extra steps, but it helps start with a more stable configuration while minimising problems during and after the installation.

In case you have a device that meets the minimum system requirements but doesn't have enough available space, it's still possible to upgrade. You only need external storage and these instructions.

You can create your very own bootable USB flash drive using the updated version of the Media Creation Tool. In addition to the tools to create a USB install media, Microsoft provides the Windows 11 ISO file. You can either use the Media Creation Tool, or you can download the ISO file directly from the official website.

The option to download the Windows 11 ISO file directly from the website is new. In the past, the only official method was to use the Media Creation Tool, but now, this has changed, and you can get the ISO file without resorting to other tools or workarounds.

02 Why isn't Windows 11 available on my computer?

If you haven't received the notification to upgrade your computer to Windows 11, it's

Windows 11 Setup

Choose which media to use

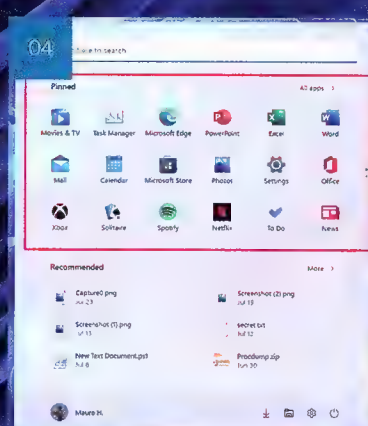
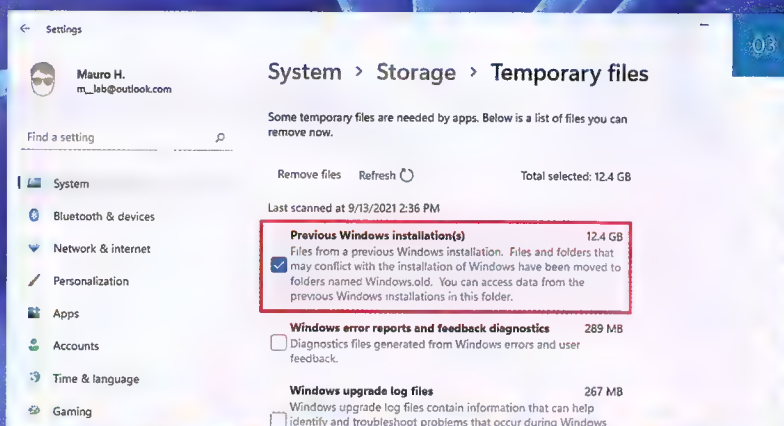
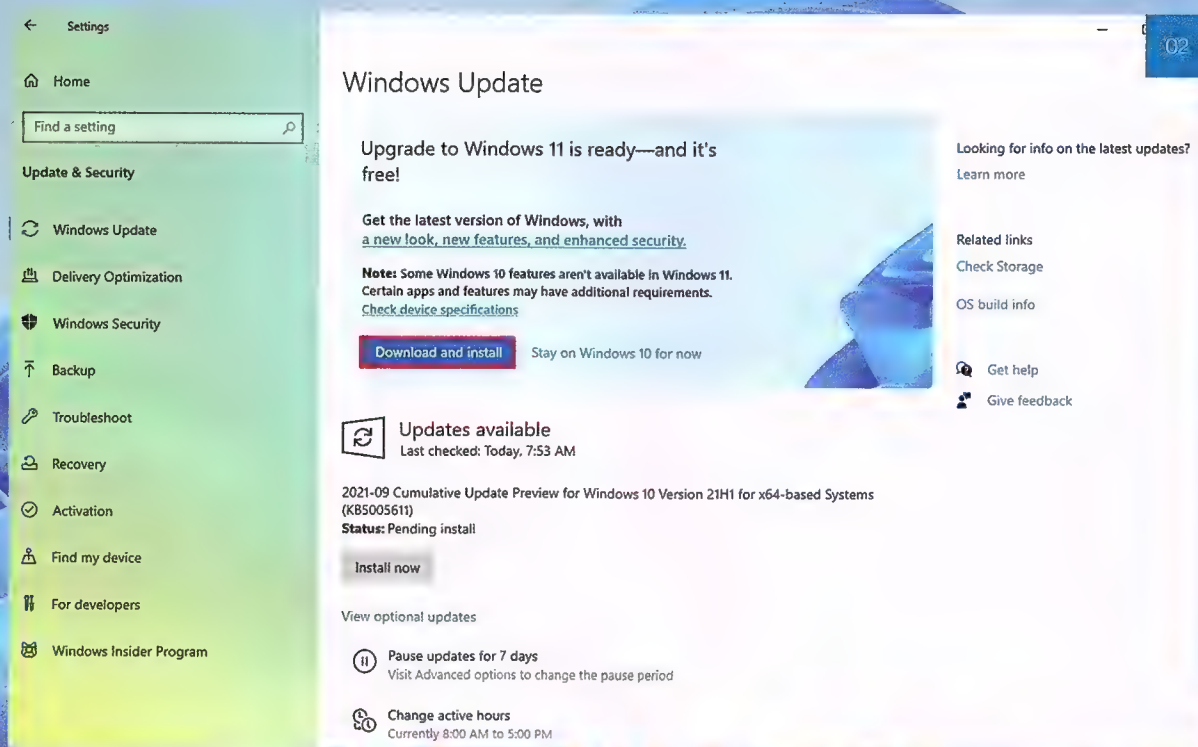
If you want to install Windows 11 on another partition, you need to create and then run the media to install it.

☒ USB flash drive

It needs to be at least 8 GB.

☐ ISO file

You'll need to burn the ISO file to a DVD later.



likely because the new version still isn't ready for your device, or the computer doesn't meet the minimum requirements.

Although Microsoft began the rollout on Windows 11 on Oct. 5, 2021, it doesn't mean that all devices will get it on day one. Similar to previous releases of Windows, the company is going with a gradual rollout approach.

During the initial phase, the software giant is using machine learning (ML) and artificial intelligence (AI) technologies to select only devices with newer hardware that are known to have a good upgrade experience. After a few weeks (or months), and after the new version has proven to be reliable, based on many factors, such as hardware compatibility, reliability metrics, and age of the computer, the rollout of Windows 11 will expand to more eligible devices.

The slow and controlled deployment will continue through the first half of

2022 when Microsoft is expected to make the new version fully available for all eligible devices. If you don't see the notification in the Windows Update settings, you shouldn't force the upgrade manually to avoid possible problems.

03 Why is my computer running out of space after the Windows 11 upgrade?

The problem is that even if the upgrade is completed successfully, the copy of the previous version will be saved for if something happens after the installation, or you are uncomfortable with the new version and want to downgrade manually.

You can reclaim the space by deleting the previous installation files using the Storage settings, but after 10 days, these files will be deleted automatically by the system.

04 What's new with the Start menu on Windows 11?

Perhaps one of the most noticeable changes on Windows 11 is the new Start menu. The new menu has been designed to be a simple app launcher that embraces traditional icons ditching the Live Tiles design and follows the new design language with rounded corners and transparent materials.

The new experience includes a search box at the top, a section for your pinned app, and recommendations. You can rearrange the icons in any way you like by dragging and dropping the icons. You can uninstall most apps from the context menu, and you can still access the list with all the apps.

The "Recommended" section includes your recent files and recently installed apps, and while you cannot remove this section, you can prevent the Start menu from showing recent items.



05 What's new with the Taskbar on Windows 11?

Windows 11 also comes with a new version of the Taskbar, which has a similar look and feel. However, the new version comes with a lot of improvements (and disappointments).

In this new version of Windows, the Taskbar appears aligned at the centre of the screen, introduces a new Start button design as well as new buttons for Search, Task View, Widgets, and Chat. You will notice new animations, and Microsoft has even added some work to the system tray.

However, to make this version a little simpler, Microsoft ended removing many useful settings, making the Taskbar a lot less functional. For example, even though you can change the alignment of the Taskbar, it's no longer possible to reposition it at the top, left, or right side of the screen. You cannot show labels, hide the date and time, change the icon size, and more.

If you like the desktop without the Taskbar, you can still enable the option to hide the bar automatically when it's not in focus.

06 What happened to Action Center on Windows 11?

Action Center is no longer a thing on Windows 11. Instead, the experience has been replaced with Notification Center and Quick Settings.

Notification Center is the place where

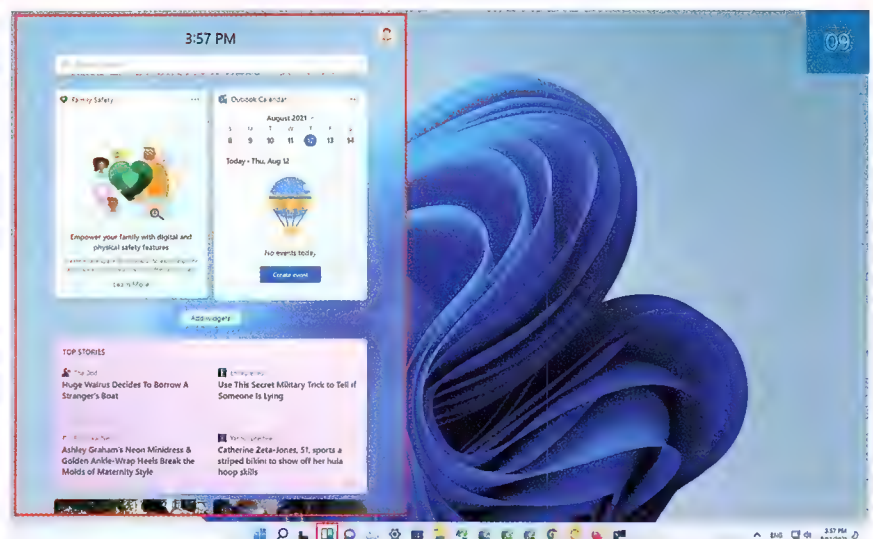
you will find all your notifications and calendar. You can open the experience by clicking the "Date & Time" button in the system tray or using the Windows key-N keyboard shortcut.

Quick Settings is where you will find quick access to common settings, such as Wi-Fi, Bluetooth, Battery, Brightness, Volume, and more. Usually, the settings in this flyout will depend upon the supported features on the computer. You can open the Quick Settings with the Windows key-A keyboard shortcut or clicking the Network and Volume icon.

07 What's new with Widgets on Windows 11?

Widgets is a new feature that provides quick access to a different type of online information without having to reach and open your phone to access the same content. It looks familiar because this is an evolution of "News and interests" already available on Windows 10 with an interface that flies from the left side.

You can open the experience using the Windows key-W keyboard shortcut or clicking the Widgets button from the Taskbar, and it can show weather, news, sports, stocks, traffic, entertainment,



Microsoft To-Do tasks, and Family Safety activities without reaching your phone to get to the same information.

08 What's new with the Microsoft Store on Windows 11?

After upgrading to Windows 11, you find a new version of the Microsoft Store app. The new app has been redesigned to a new interface to match the style of Windows 11, and there are a lot of improvements to help users make it easier to find and download apps, games, and videos.

In addition, Microsoft is making several critical changes to its policies to allow developers to publish virtually any kind of apps in the Store, including traditional Win32 (unpackaged .exe and .msi), .NET, and Progressive Web Apps (PWAs). Furthermore, moving forward, the company is letting developers keep 100 percent of the revenue when they bring their monetisation platform.

Microsoft promised support of Android apps through the Windows Store, but this will happen at a later time. Finally, the company also announced that it's now allowing third-party app stores to become part of the Microsoft Store app, and the Epic Games Store is the next in line to come to the Store.

09 Are there any multitasking improvements on Windows 11?

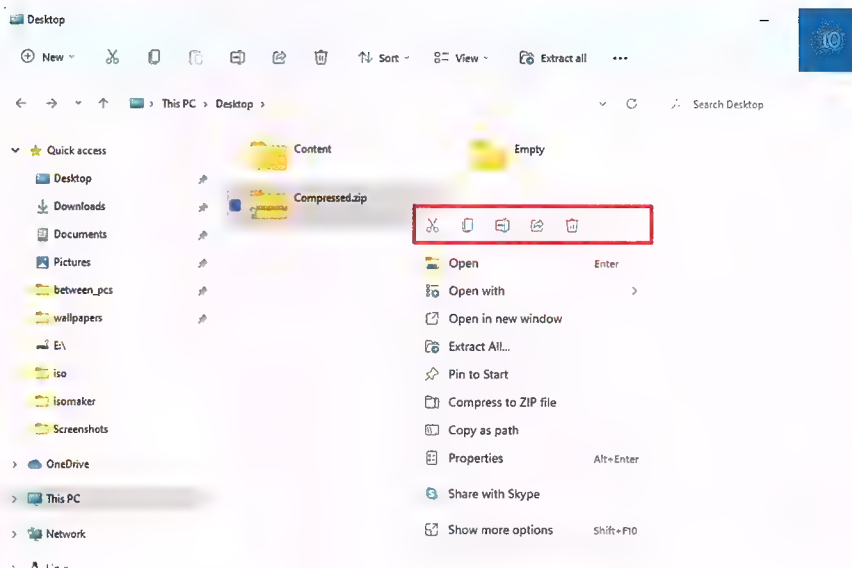
Yes, Windows 11 comes with several multitasking improvements, Snap layouts and Snap groups, Desktops, and multiple displays improvements. "Snap layouts" is a new menu that appears when hovering over the maximise button of any window, and it includes different layouts to snap windows on the screen. Once you select a layout and position, Snap assist will give you to continue snapping windows in the remaining space.

"Snap groups" is also part of the Snap assist experience, and it allows you to switch back to the group of spanned windows from the Taskbar by hovering over an app that belongs to a group and clicking the group preview.

On Windows 11, "Virtual Desktops" becomes "Desktops," and it's a feature that gives you the ability to create different virtual spaces to keep unrelated tasks separated, such as work, school, and gaming (you can use this guide to learn more on how to get the most out of this feature).

The feature works the same way as in previous versions, but it's been redesigned with an interface that now docks at the bottom of the screen, includes the ability to change the desktop background per desktop, and more.

When you disconnect your laptop to an external display, all the applications on the secondary screen will now minimise automatically. Then when you reconnect the monitor, the apps will restore



automatically to their original location by default to improve the experience when working with multiple displays.

Finally, "Aero shake," the ability to grab and shake a window to minimise all the other windows, now has its own setting on the "Multitasking" settings page.

10 Does Windows 11 come with a new version of File Explorer?

The new File Explorer features an updated user interface that matches the visuals of Windows 11 with rounded corners, new iconography, and redesigned default folders (Desktop, Documents, Downloads, Pictures, etc.). Also, since the ribbon menu has been removed in favour of a new command bar that includes all the common actions and new menus to sort items and access different settings, including the ability to enable compact view and show hidden items.

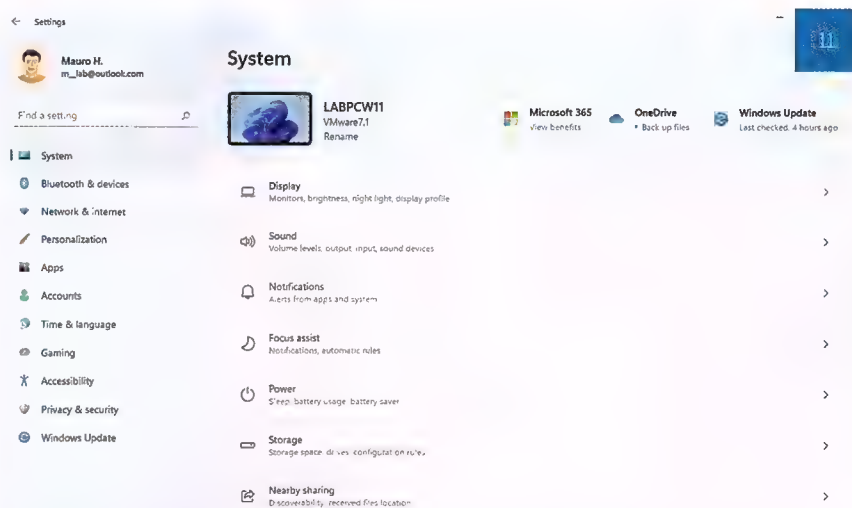
In this new version, you are also getting a new (right-click) context menu design using rounded corners, semi-transparent materials, and new icons for the different actions, including Cut, Paste, Copy, etc.

The new context menu is limited, and since many apps still don't support this new menu, Microsoft has added a "Show more options" item to access the classic context menu.

11 What's new with Settings on Windows 11?

Windows 11 comes a new version of the Settings app that includes a modern design that follows the visuals of Windows 11 with rounded corners, colourful icons, semi-transparent materials, and more. Although you will still find all the same settings as the version of the app for Windows 10, in this new version, they are grouped with a different logic, and you will find a lot of new settings.

The new Settings also ditches the homepage, and now, the app opens straight into the System section. As you move between sections, instead of listing all the pages in the left navigation pane, the pages are listed on the right side, and at the top, you will notice breadcrumbs letting you know where you are in the app.



Widgets on Windows 11

Widgets get you closer to the information you want and need.

Windows 11 comes with a new feature known as “Widgets,” which has been designed to provide different types of information. For example, weather, news, sports, stocks, traffic, entertainment, Microsoft To-Do tasks, and Family Safety activities without reaching your phone to get to the same information.

The experience is similar to the “news & interests” feature already available on Windows 10. However, instead of flying out from the Taskbar, the new feature has a different interface and flies out from the left side of the screen.

On Windows 11, the Widgets dashboard is accessible by clicking the dedicated “Widgets” button available in the Taskbar or using the Windows key-W keyboard shortcut (if you are on a touch-enabled device, you can also swipe from the left edge of the screen to open the feature).

As you open the dashboard, the interface slides over the desktop taking the full height and almost half of the screen with an interface that matches the new Windows 11 design language, including rounded corners and frosted glass background.

At the top, the dashboard shows you the current time, and the search box is there to perform web searches with Bing using Microsoft Edge. Also, the interface has two main parts, the widgets section and the personalised feed powered by AI to serve endless content to keep you informed.

01 Personal widgets

If you want to customise the dashboard, you can click the “Add widgets” button or click the profile button at the top-right of the screen.

You can add or remove widgets on the page, and you can sign in with your Microsoft account to get a more personalised experience.

Microsoft can always bring more widgets to Windows 11, but as of the time of this writing, you can select from element widgets, including:

Watchlist – Shows stocks information.

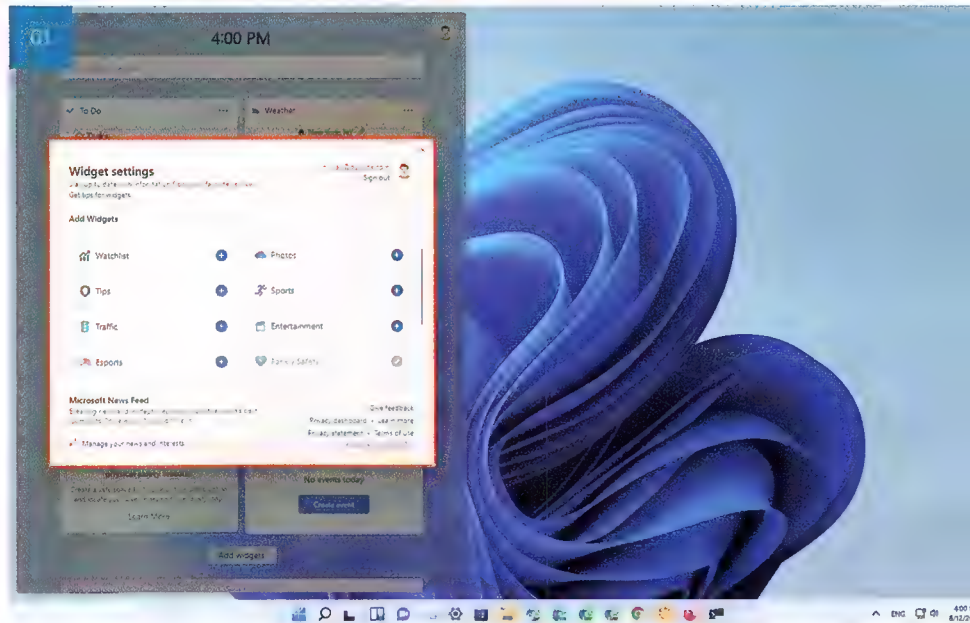
Traffic – Displays the current traffic information based on your location.

Sports – Presents information about gaming sports.

Weather – Shows the current weather information based on your location, and you click the widget, the forecast will open in the browser.

To Do – Displays tasks from your Microsoft To Do lists.

Tips – Surfaces tips to use Windows 11.



Sports – Shows games results and schedules.

Entertainment – Displays trending movies, and clicking each item will open the Microsoft Store with different ways to acquire the movie.

Family Safety – Brings up recent activities from members in the family group of your Microsoft account.

Outlook Calendar – Shows upcoming events in the calendar.

Photos – Shows a slideshow of pictures stored on your OneDrive account.

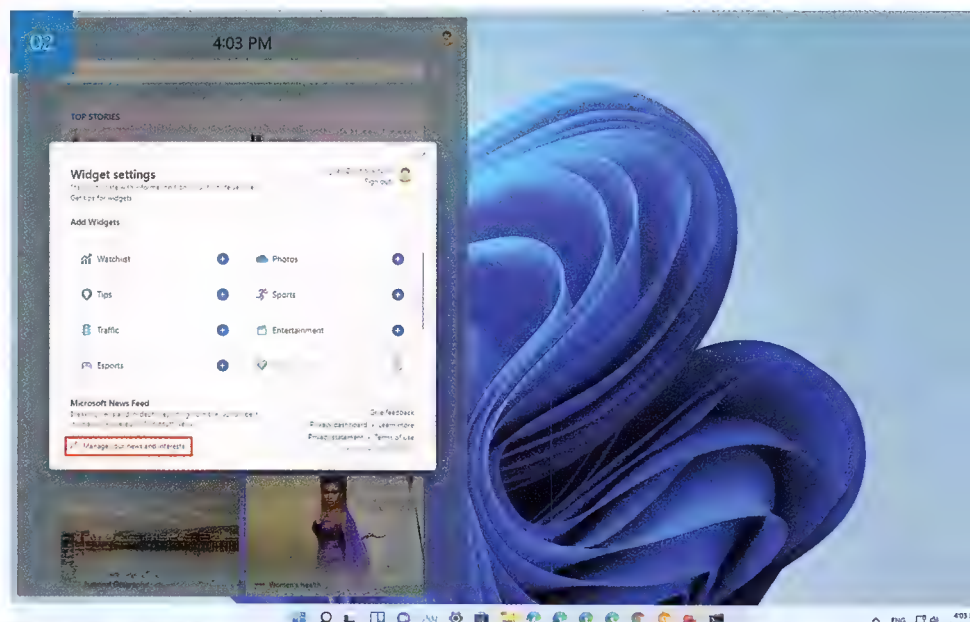
02 News widgets

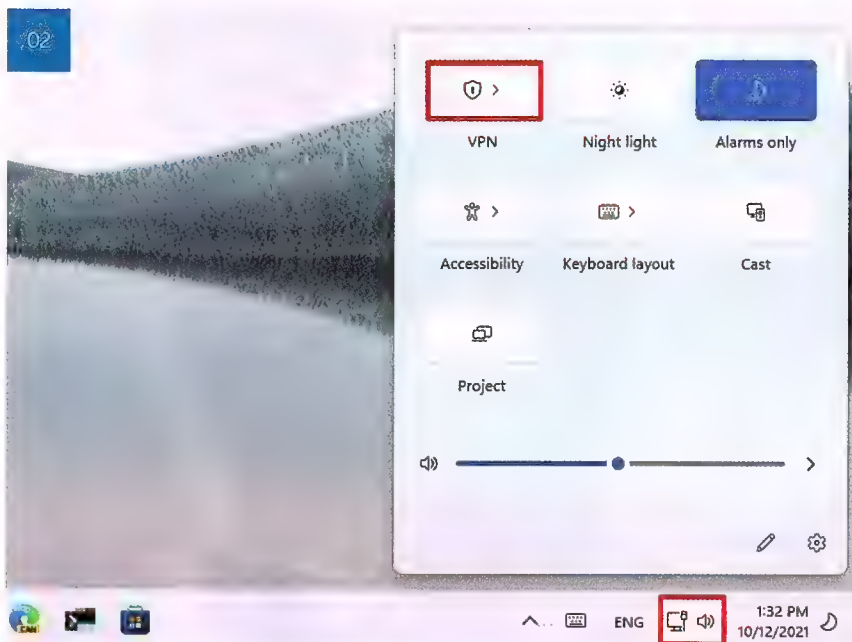
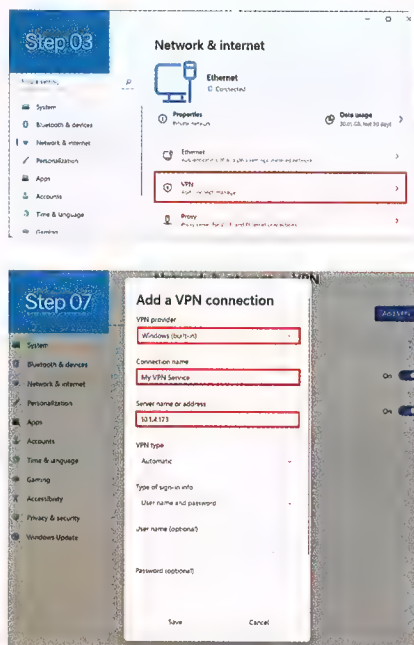
The second section is where the news widgets are located. You cannot rearrange these elements, but you can click the

three-dotted button to open the “See more” menu to thumb up or down the content to tell the feed that you want more or fewer stories from the same topic. If you don’t like a particular news outlet, you can choose the “Hide stories from” option.

You can also add comments, react by adding an emoji and bookmark the story for later viewing. The stories you save will be collected on the “My Saves” page in your MSN account.

If you want to personalise your feed further, you can click the profile button in the top-right corner and click the “Manage your news and interests” option to access the “My Interests” page to follow or unfollow content.





How to manually configure a VPN on Windows 11

If you need to connect to a VPN service manually, we'll show you how.

On Windows 11, the best VPN (virtual private network) services will provide an app to connect quickly to their private networks. However, you may still want to configure the VPN manually if the app isn't working as expected or you don't want to install an extra piece of software.

Whatever the reason it might be, Windows 11 provides an option to configure and manage VPN connections from the Settings app, which you can use to connect to virtually any VPN service to improve your online privacy and access other locations' restricted services.

To set up a Windows 11 VPN connection, use these steps:

- 01** Open Settings.
- 02** Click on Network & internet.
- 03** Click the VPN page from the right side.
- 04** In the "VPN connections" setting, click the Add VPN button.
- 05** Use the "VPN provider" drop-down menu and select the Windows (built-in) option.
- 06** In the "Connection name" setting, enter a name to identify the connection — for example, you can use the service name like IPVanish, Private Internet Access, etc.
- 07** In the "Server name or address" setting, enter the address of the VPN server — for example, `vpnserver.com` or `122.122.122.122`.
- 08** Use the "VPN type" drop-down menu and select the Automatic option or

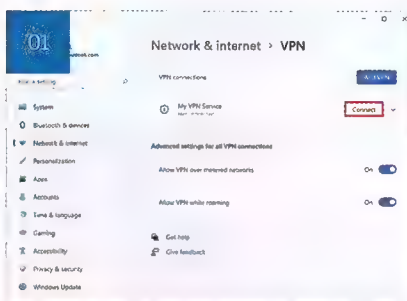
the protocol required to connect to the particular VPN server.

- 09** Use the "Type of sign-in info" drop-down menu and select the authentication method. Quick note: This option will depend on the VPN provider settings.
- 10** Confirm the username and password if you select the "User name and password" option.
- 11** Click the Save button.

01 How to connect a VPN connection on Windows 11

To connect to a VPN server, use these steps:

- 01** Open Settings.
- 02** Click on Network & internet.
- 03** Click the VPN page from the right side.
- 04** Click the Connect button for the connection



02 Connect from Taskbar

To make a VPN connection from the Taskbar, use these steps:

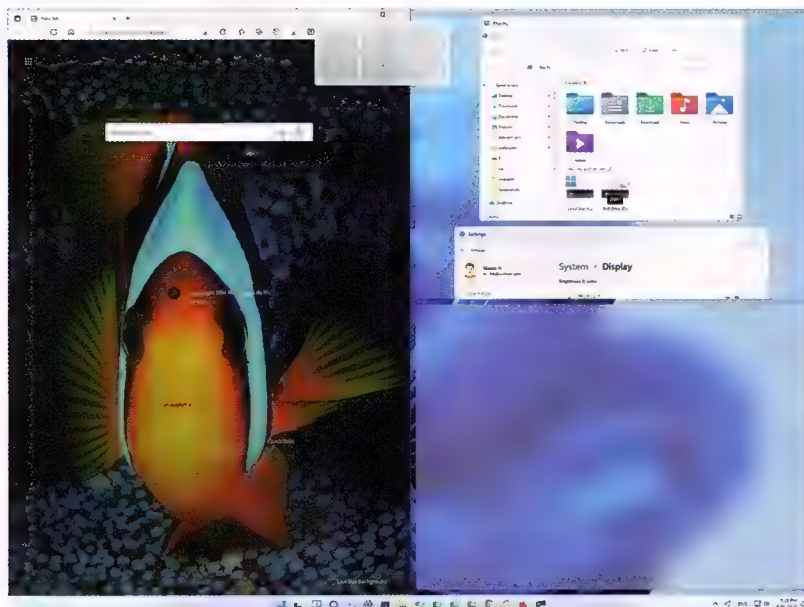
- 01** Click the network icon in the Taskbar
- 02** Click the VPN button.
- 03** Select the VPN connection.
- 04** Click the Connect button.

03 How to remove a VPN connection on Windows 11

To remove and delete a VPN connection, use these steps:

- 01** Open Settings.
- 02** Click on Network & internet.
- 03** Click the VPN page from the right side.
- 04** Click the connection to access its settings.
- 05** Click the Disconnect button (if applicable).
- 06** Click the Remove button.





Multitasking on Windows 11

You now have even more ways to multitask on Windows 11 using Snap groups, Desktops, and more.

On Windows 11, Microsoft is also improving the way users work with multiple applications with new features, such as Snap layouts and Snap groups, to make snapping windows on the desktop a little easier, especially to manage windows in wider displays.

The Virtual Desktop experience has also been updated with a new name (Desktops), a better interface, and the ability to choose a different background image per desktop. Windows 11 introduces new settings to make it easier to work with apps with external monitors, and you can now decide whether to enable or disable the title bar window shake feature.

As part of the multitasking improvements, Windows 11 brings

changes to Snap assist with Snap groups, Virtual Desktops becomes Desktops and includes a new design and various tweaks. And, you can now enable or disable the title bar window shake feature.

01 Snap assist & layouts

Snap assist has been around for a long time, and it's a feature designed to help you organise the windows on the screen quickly. Although the feature can help you snap windows perfectly on the side or corners, it hasn't been an intuitive experience for most users since they didn't have any visual aid.

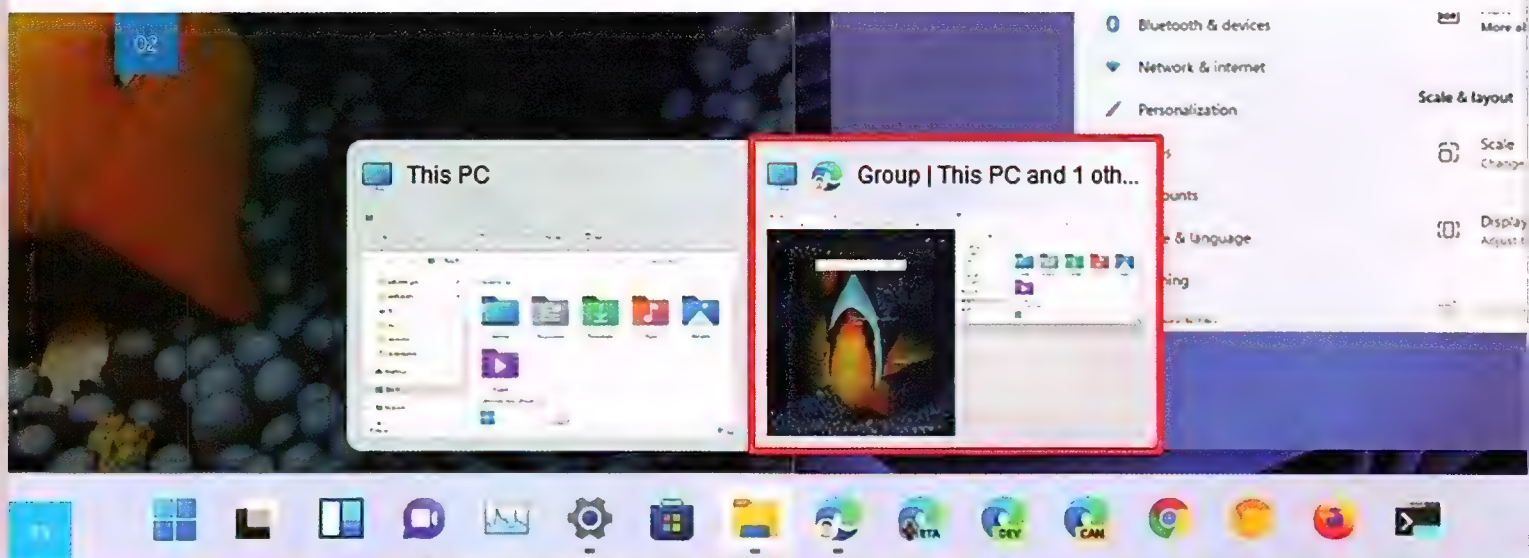
As a result, Windows 11 now ships with new features, including Snap layouts and Snap groups, to improve the

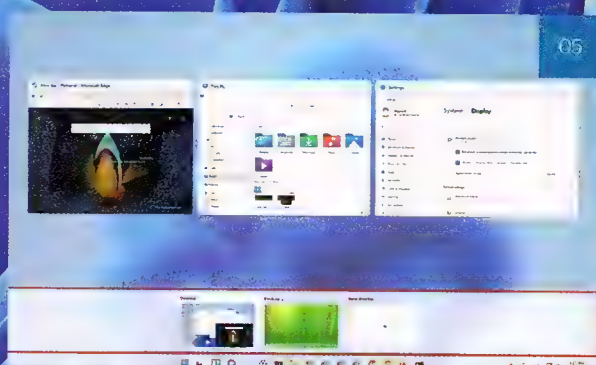
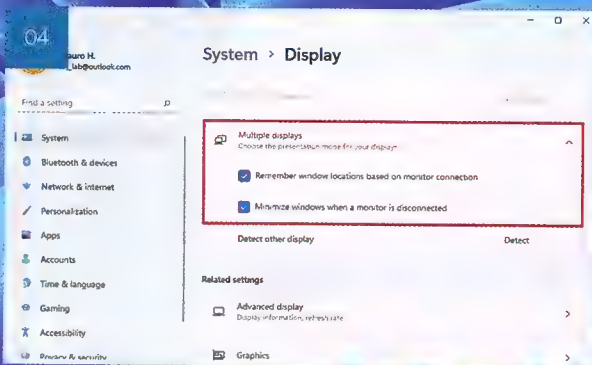
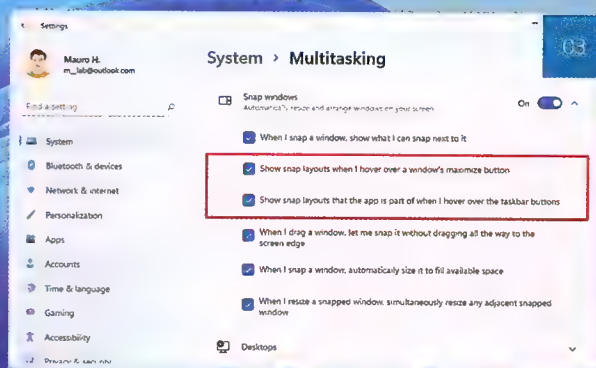
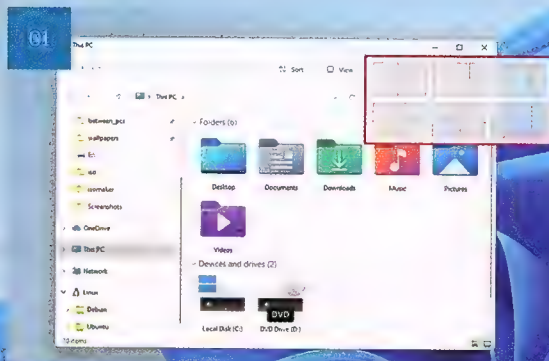
experience when multitasking with various windows.

"Snap layouts" is a feature that brings up a menu with different grids when hovering over the maximise button. Once you select a layout and position, Snap assist will guide you to continue positioning windows in the remaining zones.

In the past, Snap assist only supported around three different layouts to arrange the windows, but with Snap layouts, you now have up to six different layouts. However, the number will depend on the size of the screen.

If you are using a tablet in portrait mode, when snapping to the right and left sides of the screen, Snap assist will smartly position one window at the





bottom and the other one at the top.

When dragging windows manually to either side or corners, you will also notice that the Snap assist preview has been updated with the same interface design that Microsoft is using on Windows 11, including rounded corners and frosted glass transparency.

On Windows 11, you can open the Snap layouts menu by hovering over the maximise button or using the Windows key-Z keyboard shortcut.

02 Snap groups

Snap groups is also part of the Snap assist experience. However, it's a feature available through the Taskbar that allows you to switch to different groups of snapped windows when switching to another app. This way, you don't have to re-snap them again to get back to what you were doing a little faster.

To see Snap groups in action, you need to snap windows as you would normally do, then if you switch focus to another app, you can hover over one of the apps that belong to the snapped group, and the preview will display another preview of the snapped group, which you can choose to return to the previous group of snapped windows.

03 Snap assist settings

Snap layouts, and Snap groups come enabled by default, but you can decide to disable them from Settings > Multitasking. The option that enables or disables Snap layouts is the one that reads: Show snap layouts when I hover

over a window's maximise buttons. The option that enables or disables Snap groups is the one that reads: Show snap layouts what the app is part of when I hover over the taskbar buttons.

04 Multiple displays

Windows 11 also comes with a new feature to make it easier to use external monitors. For example, when you disconnect the external display, all the applications on the secondary screen will minimise automatically. Then when you reconnect the monitor, the apps will restore automatically to their original location.

The feature comes enabled by default, but you can choose to enable or disable it from Settings > Display > Scale & layout > Multiple displays and checking or clearing these options: Remember window locations based on monitor connection, and, Minimise windows when a monitor is disconnected.

05 Desktops

On Windows 11, "Virtual Desktops" becomes "Desktops," and in the same way as before, the ability to use multiple desktops allows you to create different spaces to keep unrelated tasks separated, such as work, school, and gaming.

Although the feature still works as before, you will find a redesigned interface and various other tweaks in this new version of Windows.

The feature starts with a new redesigned Task View button that sits in the Taskbar, and when you click it, you

will access a view that shows all your running applications and desktops. You will no longer find Timeline as it's not part of the OS anymore. Unlike the experience available on Windows 10, the desktops are at the bottom rather than at the top. You will find an interface that continues the design trend on Windows 11 with blurry semi-transparent material and rounded corners.

In the new experience, you can reorganise, create, and customise as many virtual desktops as you want, and each one can have a different background.

If you want to set a different background, you need to right-click the desktop and select the Choose background option to open the "Settings" app in the Background settings and choose the image you want.

The context menu also includes options to change the position of the desktop to left or right.

Another interesting improvement is that when changing the background image, if the Settings app is open on another desktop, it'll be forced to the desktop you invoke the Settings.

Aside from the name change and the redesigned interface, everything continues to be the same. You can continue access the experience using the Windows key-Tab keyboard shortcut. Right-clicking a running application in Task View inside a particular desktop gives you the same options. And you can still use all the same shortcuts as in the previous version of Windows.

How to optimise Windows 11 for gaming

With just a few tweaks your old Win 10 gaming PC is now a speedy Win 11 box.

01 Uncheck 'Enhance pointer precision'

Whether or not you have acceleration disabled in the bundled software of your chosen gaming mouse, it's possible that Windows is still adding a little into the mix. The 'Enhance pointer precision' feature is handy to have enabled on a laptop, keeping your trackpad usable, but on a desktop gaming setup it's worth turning off to make sure there is no acceleration in any of your games.

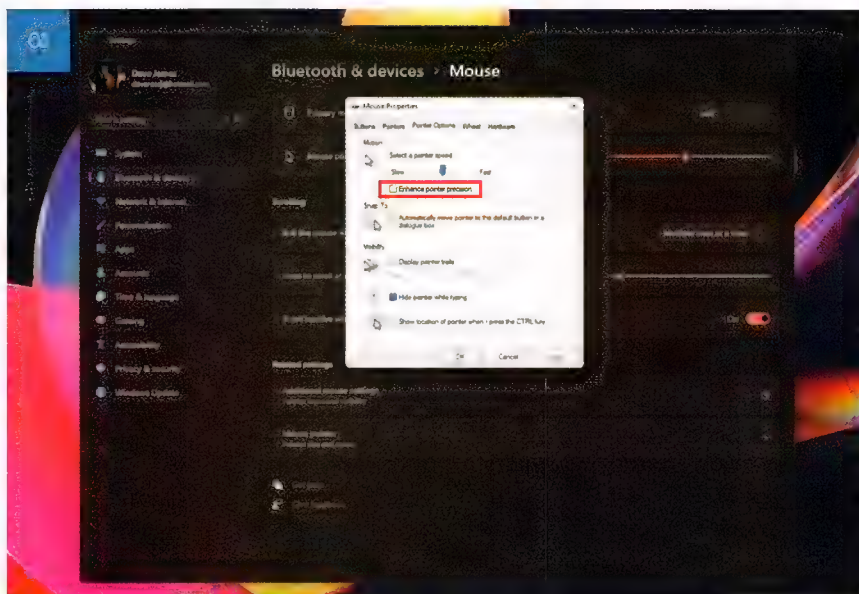
Hit the Win key on your keyboard, type Mouse, and it will bring up the relevant screen from Settings. From here click on Additional mouse settings and it will open up one of those ancient Windows dialogue boxes that haven't been redesigned since forever. Click on the Pointer Options tab and uncheck the Enable pointer precision box at the top.

It's worth noting that a lot of games will utilise raw input, which will ignore any software acceleration Windows might add, but that doesn't cover everything and you may find some MOBA or RTS games especially don't feature it.

02 Enable 'Game Mode'

Yes, you read that right. You should enable Game Mode. Microsoft has worked hard on the feature over the last six months or so to ensure any of the previous stuttering or input lag that has plagued it in the past is a fading memory. Now you can enable it without impacting performance, and avoid Windows trying to pop up with notifications, or driver updates, or deciding to restart on a whim.

Hit the Win key, type Game Mode, and then make sure the feature is enabled. It likely will be by default, but I do know some people will disable it almost because of muscle memory at this point.



03 Check GPU priorities on games

A feature that Windows 11 now surfaces is the ability to assign GPU priorities on a per-application basis. On a desktop rig, with a single graphics card that's maybe not such a big deal, as the High performance and Power saving modes only have one GPU option anyway. But, for a gaming laptop, which will have both, ensuring you're definitely using the right graphics silicon for the job is useful.

Not only for making sure you're using the discrete GPU for high performance gaming, but also, if you're on the move, being able to have a particular game only launch with the integrated graphics will save you battery. That's something I do with *Football Manager* on my laptop anyway to save battery, but this will mean I don't have to dig around the

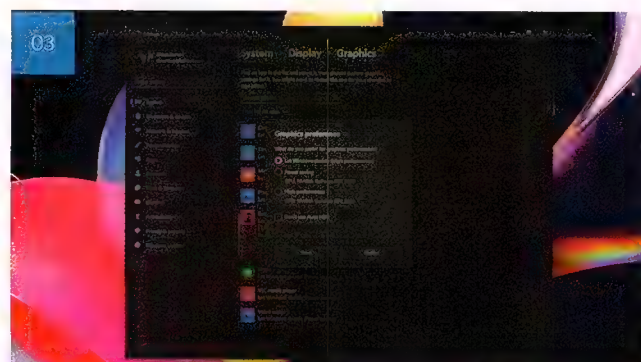
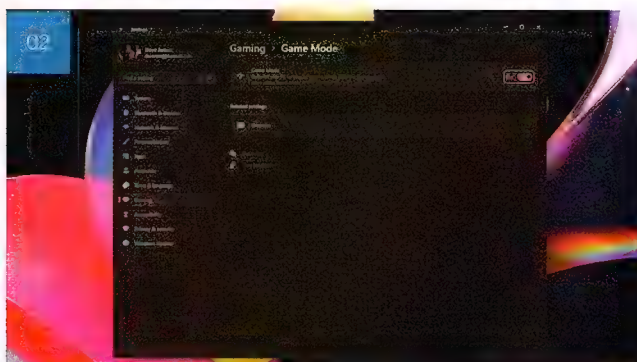
Nvidia Control Panel to do it.

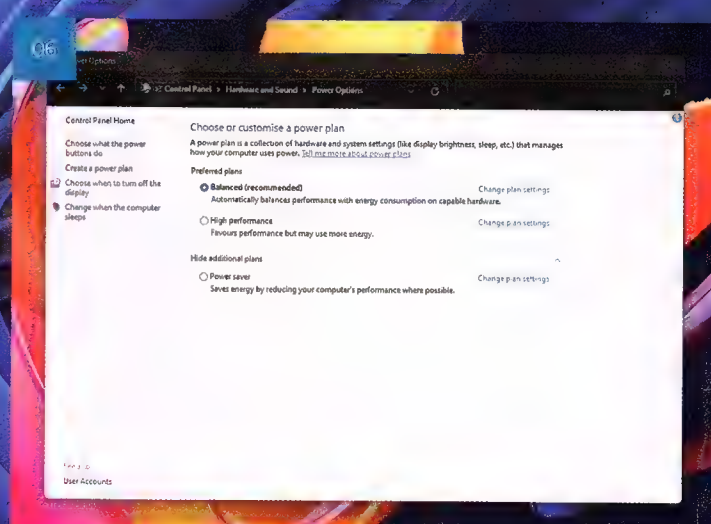
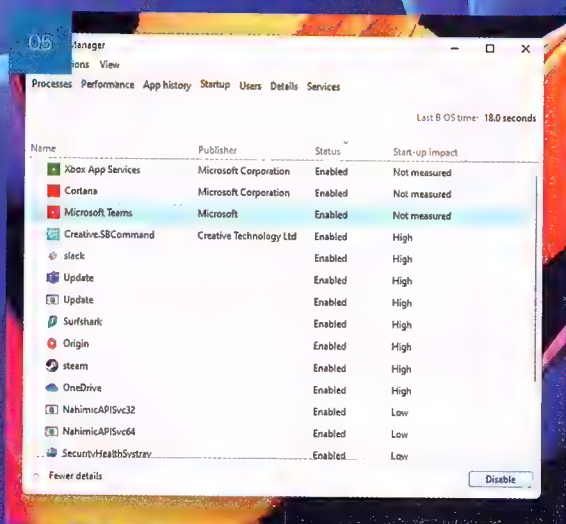
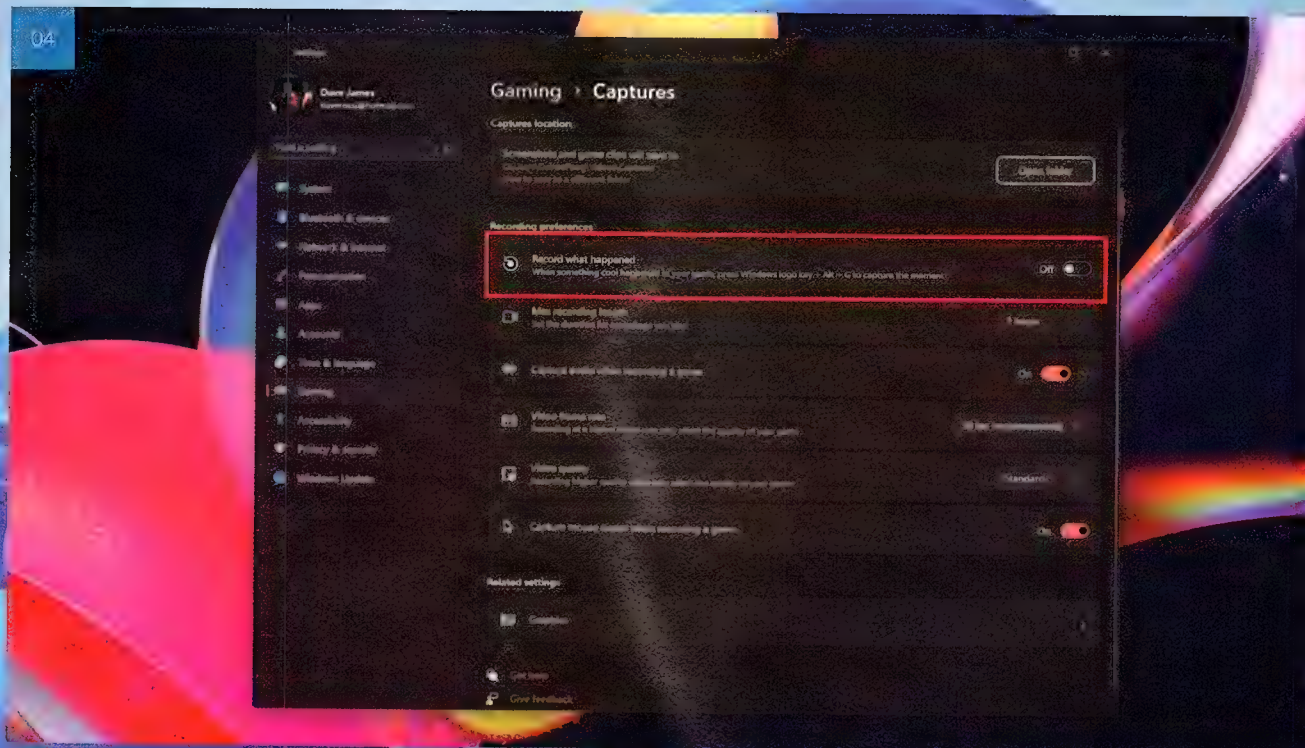
Hit the Win key and type Graphics. Then you can either go through the list of apps on the screen, or browse your PC to add a particular app on your system. Then click the app you want to prioritise in the list, hit Options, and then check whichever GPU option you would like that app to use and click Save.

Future Windows 11 updates will also give you a check box option to Don't use Auto HDR for any games that don't play nice with the new feature.

04 Disable 'Record what happened'

If you're into your game capture then chances are that you've already got a favourite app for that. Whether you're a die-hard OBS fan, or happy to go with AMD or Nvidia's driver-based capture settings, you can probably ignore the one baked into Windows.





Hit the Win key, type Capture and that will take you to the Gaming > Captures dialogue in settings. The main thing to do is make sure Record what happened is disabled as that will ensure Windows isn't recording things in the background along with Nvidia or AMD.

05 Disable unnecessary apps in Startup

A classic part of getting Windows running nicely, whether you're talking about gaming or just general system performance, is ensuring the bloatware is managed. On a fresh install you probably won't have a huge number of apps running on startup, but a few months down the line, after different drivers and peripheral apps are added to

your system, it starts to fill up.

Right-click the Windows 'start' button and hit Task Manager. Then click the Startup tab and disable any software that you don't want to launch when you login to Windows. To do that you simply have to highlight the relevant app (or irrelevant app, maybe) and click the big Disable button.

06 Check 'Power Plan'

Finally, altering your Power Plan settings might help. Though, honestly, I'm not convinced on a desktop gaming PC that it's that useful a setting to toy with. It's another one of those old menus, but if you hit the Win key, type Power plan, and click Choose a power plan, it'll allow you to pick which plan

you want. It can unleash a little extra power from your system, but in these days of dynamic, thermal-based component performance, there's a chance that letting a specific chip draw as much power as it wants could mean it hits a thermal limit quicker and throttles performance sooner.

In my testing, with a Core i9 10900K, switching between Balanced and High Performance mode made little actual difference to performance, which couldn't be simply explained away by way of variance in testing. I would suggest that realistically leaving this setting on Balanced makes the most sense. ■

System news

There's a maxim that says every second Windows version is a dud. Mark Williams explains why it's happening again with Windows 11.

When Microsoft decides to release a new version of Windows it always causes excitement with users who want to see what fancy new features and capabilities the new operating system will bring to their lives.

Six years after Windows 10 launched, Microsoft has now launched Windows 11. With whispers before it was announced that Windows 10 would be getting some big new features, they were eventually held back for the newer version altogether. Many questioned why Windows 11 was necessary at all if Windows 10 was originally going to get these new features? Indeed, one of the bigger technical improvements, DirectStorage, will be backported to Windows 10 to allow future games to still benefit on a Windows 10 PC – albeit not to the same extent as on Windows 11's redesigned storage stack. The announcement felt a bit like a money grab by Microsoft.

The new user interface in Windows 11 is nice and progresses the journey Windows 8 started and 10 continued in updating all the system settings and UI pages. Then there's the AutoHDR feature, as well as the ability to install Android apps and have them run at basically native speeds on an improved Windows Subsystem for Linux.

Once you start adding all the new features up it begins to feel



like a legitimate reason to need the new version.

The fact that programs and drivers that ran on Windows 10 will be broadly compatible with Windows 11 means the free upgrade path to Windows 11 should be a slam dunk for most. Unfortunately, Microsoft has made some decisions that will severely hamper the uptake of its latest OS.

Windows 11 has had a rocky start, like most new operating systems do. In this case soon after releasing it was found that there was an L3 cache bug on AMD Ryzen systems causing performance losses of up to 15 percent under certain circumstances, and users with Intel



MARK WILLIAMS

Mark is an IT professional with a strong interest in voiding warranties.

Killer or SmartByte network adapter software were reporting substantial bandwidth performance losses. Thankfully while these and other issues have been resolved (see tinyurl.com/APC501WIN11 for a comprehensive list) this represents the normal teething behaviour of a new operating system. The deeper issue Microsoft has is in the ability for current Windows 10 users to upgrade to Windows 11.

Microsoft is demanding that systems support Trusted Platform Module (TPM) 2.0 or better for Windows 11 to work. This immediately means you require a system with an AMD Ryzen 2000 series or an 8th Generation Intel processor or newer, and to have TPM enabled in the BIOS.

This will gate-off many users from upgrading otherwise capable computer systems. In fact, even if you have a new enough system but simply don't have TPM enabled in the BIOS (as is the default on most motherboards and systems pre-Windows 11 launch), and without knowledge of how to enable the feature, it'll prevent users from upgrading to Windows 11.

It took around two and a half years after Windows 10 launched before it had more market share than the then popular Windows 7. With these new hardware restrictions in place, I fear Microsoft will take even longer to achieve the same thing. Windows 11 has a long road to acceptance ahead of it. ■

SHOP TALK

*How has the Windows 11 launch gone for you?
Have you seen strong demand for the new OS?*

Jaimie, Leader Computers: "Its early days to say if there will be any compatibility issues, but I can say that the take up has been faster than the adoption of Windows 10 from Windows 7. It seems like more of an update than an upgrade which bodes well for consumers who want to upgrade their existing hardware as well."

Richard, Aftershock PC: "I have had strong pushback from my testing and support team not to roll out Windows 11 yet onto our builds, so we have been holding off up until now. This is largely due to the bunch of issues it introduces such as incompatibilities, bugs, random issues on various programs and games and performance dips with some Ryzen processors. From our in-depth testing, we have therefore been suggesting to our customers that they hold off at the moment until some patches are released. There was a big patch released over the weekend which is expected to fix the Ryzen issue and hopefully a bunch of other ones."

I am surprised how few people have asked us about upgrading. We spent a lot of time preparing user guides on how to do the upgrade for all the various motherboards expecting there might be a flood of people asking us, but it has only been a handful so far."

Market snapshot

A sampling of PC systems available this month.



\$2,140 – tinyurl.com/APC501AFT

AFTERSHOCK PC HYPERGATE AIR - LITE

Being \$90 more expensive than the ScorpTec system, you get a surprising amount of extra performance in this PC. For starters, the Ryzen 5600X is a big upgrade in terms of clocks and IPC over the Ryzen 5 3600, so the CPU will almost never bottleneck your gaming experience. Paired with it is a better third-party tower cooler for added cooling performance and matched with faster 3600MHz memory means the CPU can feed frames to the RTX 3060 all day without a hitch. Similar power supply and SSD specs keep things close with the ScorpTec system. The better looking Nxzt chassis gives this system an air of class. Though the HDD being half the size is a shame in an otherwise very strong build.

CPU: AMD Ryzen 5 5600X; **Cooler:** Aftershock M-40 Frost Performance Cooler; **M/board:** Gigabyte B550 Gaming X V2; **Graphics:** MSI RTX 3060 Ventus 2X OC 12GB; **Memory:** 16GB Kingston Fury 3600MHz; **Storage:** 512GB Aftershock M.2 NVMe SSD, 1TB Western Digital Blue 7200RPM HDD; **PSU:** 650W Asus TUF Gaming; **Case:** Nxzt H511 Flow



\$6,259 – tinyurl.com/APC501PLE

PLE COMPUTER ZEPHY

Intel's 12th gen Alder Lake is here, and this is one of the first PCs on offer. This system has the top of the range 12900K, offering insane levels of single and multithreaded performance with its eight performance cores and eight efficiency cores, serving up 24-threads in total. To be honest it's overkill for a pure gaming system, so be sure that you will be using the extra horsepower when considering this PC. This processor is a power-hungry beast, and it's paired with a 360mm AIO cooler to keep the temperatures tamed, with a powerful PSU to feed this and the GPU. 32GB of new DDR5 is likely to become the new standard moving forward but by today's standard is generous. Given the cost of this system the SSD and HDD could've been bigger.

CPU: Intel Core i9 12900K; **Cooler:** Gigabyte Aorus Waterforce X 360 RGB AIO; **Motherboard:** Gigabyte Z690 Aorus Master eATX; **Graphics:** Gigabyte GeForce RTX 3080 Gaming OC LHR 10GB; **Memory:** Corsair 32GB Kit DDR5 Dominator Platinum RGB 5200MHz C38; **Storage:** Gigabyte Aorus Gen4 1TB NVMe M.2 SSD, Seagate BarraCuda 2TB 7200RPM HDD; **Power Supply:** eVGA SuperNova G5 1000W; **Case:** Fractal Design Torrent Dark



\$2,049 – tinyurl.com/APC501SCO

SCORPTEC VERSA RX 6600 XT

Containing one of AMD's newer release graphics cards in the RX 6600 XT, this system will outpace the likes of the RTX 3060 easily making this system potentially faster than the slightly more expensive Aftershock system. However, the ageing CPU – while decent enough for most things – may bottleneck the GPU a little especially if you're only playing at 1080p and in search of high frame rates. The paired memory is a nice match for the CPU. The motherboard is adequate but with only six USB ports on the rear IO, it could feel a little constrained if you have a lot of peripherals. With a good enough power supply and mass storage, this system is a well-rounded build that tries to keep costs down in these difficult times.

CPU: AMD Ryzen 5 3600; **Cooler:** OEM; **Motherboard:** Asus Prime B550M-A WiFi; **Graphics:** Asus Dual Radeon RX 6600 XT OC 8GB; **Memory:** Thermaltake ToughRAM RC 16GB 3200MHz DDR4; **Storage:** Western Digital Blue SN550 500GB M.2 SSD, Seagate BarraCuda 2TB HDD; **Power Supply:** Thermaltake Smart BX1 650W; **Case:** Thermaltake Versa H18 Black

\$5,499 – tinyurl.com/APC501MWV

MWAVE RESPAWN NINJA FINAL BATTLE

Giving the 10th gen a last hoorah is this Final Battle system from Mwave. Sporting a 10-core processor that was absent from the 11th generation of Intel processors, this system offers up plenty of processing grunt for any number of productivity tasks. Clocking up to 5.2GHz as well and being paired with the ever-popular RTX 3080 will offer you plenty of scope to either go for high quality and high resolution or super high fps at lower resolutions with out much of a bottleneck in either direction. The choice of Gundam-themed parts in this white themed build is perfect. The water cooler AIO could've been white as well, a missed opportunity by Mwave. A large 2TB SSD is fantastic for this calibre of system and the very generous 4TB HDD will hold just about anything.

A very powerful system with looks to match.

CPU: Intel Core i9 10850K; **Cooler:** Cooler Master MasterLiquid ML360 Illusion; **Motherboard:** Asus Z590 Wifi Gundam Edition; **Graphics:** Asus Gundam GeForce RTX 3080 OC 10GB; **Memory:** Corsair Vengeance RGB PRO 32GB DDR4 3200MHz; **Storage:** Samsung 970 EVO Plus 2TB NVMe M.2 SSD, Seagate 4TB HDD; **Power Supply:** Asus ROG Strix 850W White Edition; **Case:** Phanteks Eclipse P600S ■



PC BUILDER

Budget

A perfect balance between price and performance.

Finally, CPU stocks have reached a stable level. AMD's Ryzen 3 3100 has remained in the budget AMD build, and for good reason. Firstly, \$200 is a reasonable price tag for this chip. Secondly, it's great for what we want. The 8-thread CPU gives us a decent experience with the addition of boosted speeds over the Ryzen 3 1200 from two issues ago. For now, it can sit comfortably in this build. The motherboard remains the same. The addition of the Ryzen 3 3100 brings a few perks, one of which is PCIe 4.0. We upgraded last time to the MSI B550M Pro motherboard to speed up data transferring in our budget AMD build. Paired with the PNY CS3040 SSD we added last time, this will ensure ultra snappy speeds. This Gen4 M.2 SSD is one of the fastest we can find and it's good value too, although 500GB can be used up pretty quickly. Some GPU prices are falling, but ever so slowly and you're lucky to find a card more than \$10 - \$20 cheaper than it was a month ago, so we're not making any changes on that front this month.

Gigabyte's DS3H V2 availability is unchanged so the Asrock B460M Steel Legend stays for our budget Intel build motherboard. We save a bit on the CPU, but nothing spectacular. The Core i3-10100 has fallen by \$10, but we will take anything at this rate.

The 1TB Western Digital hard drives in both budget machines still cost \$60. It's a brilliant budget storage solution and unless a higher capacity drive sneaks into this price bracket, we can't see it going anywhere. The price doesn't differ for

our SSD either. We don't want to 'if it ain't broke don't fix it' for our budget builds, but the market for this sector hasn't opened up any more potential parts that can knock off what we already have.

Hopefully, with Alder Lake's release pending, we will see a fall in older Intel chips that can break into the budget category. GPUs are still scorching hot, price-wise. We won't be spending upwards of 200 percent RRP for some GPUs, especially not second-hand ones.



AMD INGREDIENTS

PART		PRICE
CASE	Corsair 4000D Airflow	\$130
PSU	500W EVGA BR 80+ Bronze	\$90
M/BOARD	MSI B550M PRO AM4	\$130
CPU	AMD Ryzen 3 3100	\$200
GPU	AMD Radeon RX 6700 XT 12GB	\$1,250
RAM	16GB (2x8GB) Crucial Ballistix @ 3200MHz	\$120
SSD	500GB PNY CS3040 M.2 NVMe Gen4 SSD	\$135
HDD	1TB WD Blue 1TB 7200	\$60
OS	Windows 10 Home 64-bit OEM	\$60
PRICE		\$2,175

INTEL INGREDIENTS

PART		PRICE
CASE	Corsair 4000D Airflow	\$130
PSU	500W EVGA BR 80+ Bronze	\$90
M/BOARD	Asrock B460M Steel Legend	\$140
CPU	Intel Core i3-10100	\$190
GPU	Nvidia GeForce RTX 3060 12GB	\$1,300
RAM	16GB (2x8GB) Crucial Ballistix @ 3200MHz	\$120
SSD	500GB Crucial P2 PCIe 3.0 M.2 SSD	\$90
HDD	1TB WD Blue 1TB 7200	\$60
OS	Windows 10 Home 64-bit OEM	\$60
PRICE		\$2,180



PC BUILDER

Mid-range

A very much game-ready machine, ready for demanding regular work, too.

We were considering going for AMD's slightly cheaper Ryzen 5 5600G chip as our Ryzen 5 5600X CPU is unfortunately not on sale anymore. Because of that, we ended up sticking to the pricier chip due to the faster performance, although you lose out on the integrated graphics. That said, if you do manage to grab one, you won't be disappointed with the 5600G CPU.

The great news this month is that average prices for an RTX 3070 have fallen by \$2-300, making our build that much cheaper than last month's. The same can't be said of the AMD RX 6800 XT, which is holding steady at around \$2,000. This seems particular to the 6800

XT. As you'll see in our Turbo build, the faster AMD 6900 XT has dropped by around \$500 compared to last month, while the equivalent RTX 3080 has maintained its still-high price. So, it always pays to check.

The motherboards are still suitable for our mid-range builds too.

Memory pricing is stable, and relatively low – as it's been for many months thank goodness. The Team Vulcan 3600 kit in our AMD build remains a great buy so no changes there. We've also decided to keep the Intel version's sticks from last time round, with the Kingston Fury Renegade sticks still providing us with plenty of

good performance.

A good bet for an SSD in the Intel PC at the moment is Corsair's 500GB Force MP600 PCIe 4.0 drive. It's a reasonable price, particularly for a 4.0 drive. In the last issue, we placed this SSD in both the Intel and AMD builds, but after finding the 500GB Samsung 980 Pro selling for a very appealing \$160 we're placing that in the AMD system – though it would be a fine fit for the Intel build, too. As always, we do like to split things into a couple of options for you when we compile these builds if a component is compatible with both systems.

AMD INGREDIENTS

PART		PRICE
CASE	Lian Li PC-O11-Dynamic	\$210
PSU	650W Fractal Design Ion Gold	\$140
M/BOARD	Asus AM4 TUF Gaming X570 -Plus WiFi	\$330
CPU	AMD Ryzen 5 5600X	\$440
COOLER	240mm Cooler Master Masterliquid ML240L RGB	\$100
GPU	Nvidia GeForce RTX 3070 8GB	\$1,650
RAM	16GB (2x 8GB) Team Vulcan Z CL18 @ 3600MHz	\$140
SSD	500GB Samsung 980 Pro NVME M.2 PCIe 4.0 SSD NEW	\$160
HDD	1TB WD Blue 1TB 7200	\$60
OS	Windows 10 Home 64-bit OEM	\$60
PRICE		\$3,290

INTEL INGREDIENTS

PART		PRICE
CASE	Lian Li PC-O11-Dynamic	\$210
PSU	650W Corsair TX650M 80+ Gold	\$95
M/BOARD	ASRock Z590M PRO4	\$230
CPU	Intel Core i7-11700K	\$600
COOLER	240mm Cooler Master Masterliquid ML240L RGB	\$100
GPU	AMD Radeon RX 6800 XT 16GB	\$2,000
RAM	16GB (2x 8GB) Kingston Fury Renegade RGB @ 3600MHz	\$160
SSD	500GB Corsair Force MP600 M.2 PCIe 4.0	\$170
HDD	1TB WD Blue 1TB 7200	\$60
OS	Windows 10 Home 64-bit OEM	\$60
PRICE		\$3,685



PC BUILDER

Turbo

The maximum PC.

For both builds, we have a terabyte of ultra-fast PCIe 4.0 SSDs. The price of the Samsung 980 Pro is like a yo-yo at the moment. Thankfully, it has gone down and is available again for around \$280 so we can add it into the AMD rig. This means for this month, we can keep the speeds slightly above the Sabrent model we swapped out, for now at least. Gigabyte's 7000s is out of Intel's system. Currently, this is out of stock, so we have also opted for the Samsung 980 Pro on this side of the fence too.

Both our builds continue with 4000MHz memory this month. The previous G.Skill Ripjaws V RAM have

slipped back in due to being cheaper and more readily available than the Trident Z Neo's we had in. Both have nippy speeds of 4000MHz and are in the two 16GB configuration, so we can't complain, considering the prices of these RAM sticks.

Other than the RAM and SSD, nothing changed on the Turbo AMD machine. The Intel Turbo build sticks with the same MSI MAG Z590 Tomahawk Wi-Fi motherboard, to match its MSI MAG cooler. It's on sale, down to \$220, so with PCIe 4.0 support and great overclocking capabilities to get the most out of our 4000MHz RAM,

it's a sensible selection. Both the CPU and MSI MAG cooler have dropped a little in price too, which is always nice to see.

The big win this month, though, is discovering that prices for the AMD RX 6900 XT have fallen by up to \$500 – a minor miracle in this silicon-starved world. We don't know how long that will hold, or indeed if it's going to continue falling. They're widely available in stock at the time of writing, so as we look as the Nvidia RTX 3080 price basically not changing at all the time is right to go Red for graphics. ■

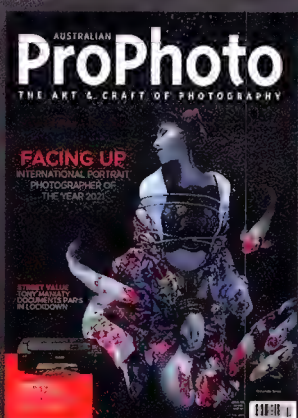
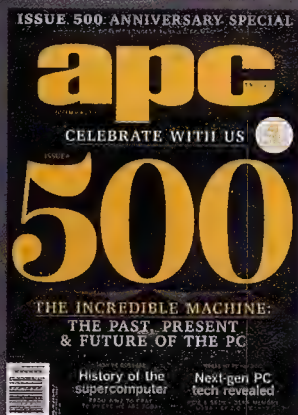
AMD INGREDIENTS

PART		PRICE
CASE	Phanteks Enthoo Pro 2 Tempered Glass	\$220
PSU	750W Nzxt C750 80+ Gold	\$140
M/BOARD	MSI MPG X570 Gaming Edge Wi-Fi	\$260
CPU	AMD Ryzen 7 5800X	\$630
COOLER	Corsair iCUE H150i ELITE CAPELLIX AIO 360mm	\$270
GPU	Nvidia GeForce RTX 3080 10GB	\$2,400
RAM	32GB (2x 16GB) G.Skill Ripjaws V 32GB @ 4000MHz NEW	\$400
SSD	1TB Samsung 980 Pro M.2 PCIe 4.0 SSD NEW	\$280
HDD	2x 3TB WD Blue 5400 HDD	\$210
OS	Windows 10 Home 64-bit OEM	\$60
PRICE		\$4,870

INTEL INGREDIENTS

PART		PRICE
CASE	Phanteks Enthoo Pro 2 Tempered Glass	\$210
PSU	750W Fractal Design Ion Gold	\$160
M/BOARD	MSI MAG Z590 Tomahawk Wi-Fi	\$220
CPU	Intel Core i9-11900K	\$800
COOLER	MSI MAG CoreLiquid 360R AIO	\$170
GPU	AMD Radeon RX 6900 XT 16GB	\$2,000
RAM	32GB (2x 16GB) G.Skill Ripjaws V 32GB @ 4000MHz NEW	\$400
SSD	1TB Gigabyte Aorus Gen4 7000s M.2 PCIe 4.0	\$290
HDD	2x 3TB WD Blue 5400 HDD	\$210
OS	Windows 10 Home 64-bit OEM	\$60
PRICE		\$4,520

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PC BUILDER MASTERCLASS

AMD vs Intel build off!

Red vs Blue, youth vs experience, and an integrated graphics build-off for the ages.

There's nothing we enjoy more at APC than a good old-fashioned build-off challenge. In the world of absent GPUs and cryptocurrency madness, however, the traditional Intel vs AMD "who can build a better productivity machine" argument just didn't hold much water. It's hard to recommend building a workstation PC if you can't buy the workstation parts.

So with that in mind, we decided to try a different take on that age-old fight. This issue, we pit the best of integrated graphics against one another: AMD vs Intel; Red vs Blue; Market Leader vs Underdog. In one

corner you have Zak Storey, APC's long-time team member, complete with 19 years of PC building experience, and no less than 81 individual PCs built under his careful eye. In the other corner, Sam Lewis, relative newcomer complete with a total of two PCs built in his short time on this prestigious title.

But arguably the far more important question is who will win the battle of the builds, and take the crown of integrated-budget-PC-that-doesn't-cost-as-much-as-a-full-GPU-these-days champion? Read on to find out.

AMD behemoth

Although the Phanteks P400A is a slick-looking case, the build's attention isn't strictly focused on this or the machine's looks for that matter. We're sorry people, there is no off-the-wall flashy RGB here. The battle's main focus is on which is the better chip to side with for an integrated graphics rig, AMD or Intel? Yes, it's an age-old debate between AMD or Intel, much like the great PlayStation or Xbox wars of yesteryear.

We get it, it's not always a clear-cut verdict either. There may be many pros and cons of both and that's what we are hopefully going to explore with this build-off. We are hoping to show that you can get a decent gaming experience without the need for GPUs or hefty AIO coolers – and demonstrate the differences between an AMD or Intel build with this format applied. Of course, we aren't expecting 4K with the sliders on full whack here, but we should get Full HD gameplay with

steady decent frames.

The AMD Ryzen 7 5700G chip we have should put up a good fight in this battle, it's probably one of the best choices for an AMD chip without the use of discrete graphics. This eight-core 16-thread chip is AMD's first 7nm 'Cezanne' Zen 3 APU (accelerated processing unit). It comes with a 3.8GHz base and a 4.6GHz boost clock. Like all Zen3 chips, the interface steps up from DDR4-2933 to DDR4-3200. With the integrated GPU, this will help boost gaming performance. For AMD processors, RAM speed matters.

The best you can really get is 3733MHz sticks as the chip's memory controller cut off at that speed, but they aren't exactly the easiest to find at the moment. We have gone with two 8GB 3600MHz Crucial Ballistix RAM sticks, which will be more than good enough to get fast memory speeds for our machine.

Although a specific price wasn't the MO for the builds, we have

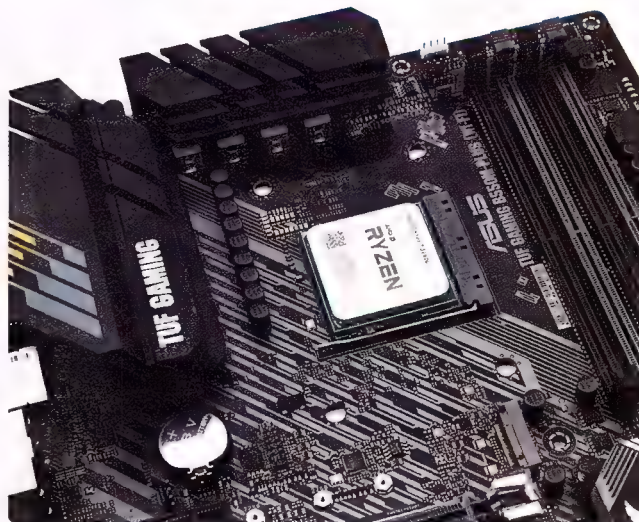
tried to keep things on the budget to a mid-range scale. The lack of GPUs should certainly help with this, although prices are slightly better than they were a few months ago. This should be an interesting challenge and we are excited for the outcome and what we can achieve through processors with integrated graphics.

Case	Phanteks Eclipse P400A	\$110
Motherboard	Asus TUF Gaming B550M-Plus (Wi-Fi)	\$220
CPU	AMD Ryzen 7 5700G	\$520
Memory	16GB (2x8GB) Crucial Ballistix 16 DDR4-3600 CL16	\$130
Storage	Western Digital Black SN750 1 TB M.2 PCIe 3.0 SSD	\$180
PSU	Corsair CV 450 W 80+ Bronze	\$60
Total		\$1,220



01 The barebones

There is no change here with the first step for both of our machines. It's off with the panels for this Phanteks P400 on the AMD build. It's great to see exactly what you are working with and give yourself as much room as possible. The tinted glass panel comes off easily once the four corner screws are removed. Thankfully for this case, they aren't as fiddly as they often are on PC cases. Speaking of the devil, two of these more fiddly thumb screws are found around the back securing on this panel. Our advice, use a screwdriver for these ones. For the front panel, you need to give it a hard pull from the bottom to pop it off. It's always scary the first few times but don't sweat – it should be fine, fingers crossed.



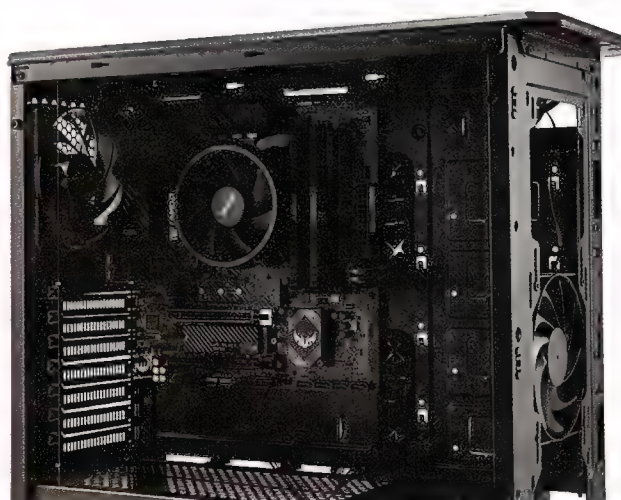
02 In goes the chip

We now turn our attention away from the case and to our motherboard and more precisely, to the AMD chip itself. Like an Intel processor, the AMD chip has a tiny arrow on one corner that will align with an arrow on the motherboard. First, though, we need to lift up the retention arm by pushing it down and outwards slightly before placing the chip down. Once this arm is up, we can now align the processor in place and rest it down. Always be careful here – pick it up by its sides and avoid touching the bottom pins. Then, secure it in place by lowering the retention arm back down. Lovely job.



03 Get chill

As integrated graphics are one of the main talking points of this build-off, the CPUs come with designated coolers. It's no real difference to fitting an AIO cooler, just with a lot less flapping around trying to fit in the radiator and extra fans. First, we need to secure the backplate onto the motherboard. After this, we need to apply a pea-sized drop of thermal paste onto the CPU, and gently align the cooler on top giving an even pressure. Once the screw holes are in the right position, tighten them up corner to corner to ensure an even tension. Right, up to speed? Before we are done with this, plug in the CPU cooler fan cable into the motherboard. And that's it, for now.



05 All aboard

Let's get this installed. To make life a little easier, we connect up the main CPU cable first from the PSU. This is in the top left corner of the board and is a tight space to connect after installing the board. We also clip the I/O shield into the case before angling the motherboard in place ready for screwing. There are eight screw holes to secure the board into the case, but don't worry if some are too awkward to reach, as long as the screws are spread apart and the tension isn't just in one corner. After this, we connect up the power switch motherboard cable into the pins at the bottom of the board. This again is pretty fiddly – it's a running theme with PC building, but all part of the fun! Just be careful not to bend any pins as they are pretty delicate.



04 install memory and storage

Thankfully, these builds without GPUs and AIO coolers are generally less of a brain-bashing experience and this next step is one of the easiest. We now need to add the memory and storage. First, the RAM sticks slot in by releasing a clasp on the top and pushing in. It will only go in one way so check the bottom groove aligns properly. Also, if you are using two sticks like us, you must check the mobo's manual to slot them into the correct DIMM slots. As for the SSD, this slides into the connector at a 30° angle. Then a tiny screw secures it onto the motherboard. We mentioned how easy these steps are, but this can be a little fiddly and brain-frying, oh the irony!



06 PSU pump

To finish off this build, we need to add the PSU. This Corsair CV450 unit has one single exit port out the back where all the cables come from, so no independent cables here. Because this is a lighter build with no GPU and AIO cooler, we only need to connect the 24-pin and USB cable as we have already connected up the CPU one earlier, no SATA or PCIe here folks. The case has decent cable management at the back and enough room behind the PSU to store excess cables. We fed the two cables we needed through some rubber slots to the front and clip them into the board. Then using four screws, we secured the PSU into the bottom of the case, and hey presto, the PC is ready – nearly. We do a bit of cable management with the cases' velcro straps, then pop on the side panels, tighten them up, then pop on the front of the PC.

Intel build

You know, the Intel Core i5-11600K has been in a lot of our builds lately. It's one of those chips that is handy to have and sits on the cusp of pretty much every area when it comes to a blue build like this. For instance, we originally considered running the Core i5-11400 instead, but the graphics are a step down (HD730 instead of HD750). Go any higher, with a Core i7 or Core i9 for example, and you don't really gain anything from an iGPU perspective, outside of increased core count (and cost).

It's funny, because back in the day, from Sandy Bridge all the way up to the 6th series Skylake parts, it was almost a cliché for tech journalists to say "Unless you really need hyperthreading, get an i5!". AMD came in and ripped up the market with ridiculous core counts and hyperthreading throughout, and it changed the very notion of what sort of chip you should get. But now, with AMD's core

count peaking, and Intel catching up and matching its feature sets (this hex-core features hyperthreading for 12 threads total, and oodles of IPC performance, too), we're sort of back to where we were, at least for recommendations on Intel anyway. Unless you really need those extra cores, the i5-11600K is a darn fine chip.

The only downside to the Core i5-11600K compared with the chips of yesteryear, is the fact it needs a decent cooler. This is exactly what prompted our next investment, the be quiet! Dark Rock TF 2 CPU cooler. It's a low profile, all-black little number that packs in some serious TDP alleviation with an epic fan too.

Pairing that with a Corsair iCUE 220T RGB case, complete with three intake fans, an MSI MAG B560M Mortar motherboard, 16GB of Corsair Vengeance LPX (a trusty favorite), and of course, 1TB of pristine PCIe 4.0 M.2 storage (something our AMD Ryzen 7 5700G, just can't match

amazingly), and what you're left with is a souped-up Team Blue iGPU machine, ideal for work and light play, for just under \$1,400. Is there anything we could have dropped from this build? Of course, there is. But we'll get to that later.

Case	Corsair iCUE 220T RGB Airflow	\$130
Motherboard	MSI MAG B560M Mortar WiFi Micro ATX	\$220
CPU	Intel Core i5-11600K	\$420
CPU Cooler	be quiet! Dark Rock TF 2	\$120
Memory	16GB (2x8GB) Corsair Vengeance LPX DDR4-3200 CL16	\$100
Storage	1TB Western Digital Black SN850 PCIe 4.0 M.2 SSD	\$280
PSU	be quiet! System Power 9 CM 500W 80+ Bronze	\$80
Total		\$1,350



01 Panel stripdown

As ever with our builds, we start by stripping and removing every element of the case that might get in the way during the build process. This means removing the tempered glass window, rear panel, any fan filters and meshes, and the front panel too. You can also take the opportunity to remove the hard drive caddy if you don't intend to use the old 3.5-inch standard drives, as it will give you more space to maneuver in the bottom of the case when installing the power supply. This isn't the first time we've used this chassis, as we notice that two of the PCIe slot covers have been removed prior to this build. An ominous metaphor for the GPU industry as a whole right now, we feel.



02 Mortaring along

We're going TO PREP most of this build outside the case. It isn't absolutely necessary but makes things easier when you're installing coolers, backplates, and M.2 drives. First up is the most delicate part of the build, installing the processor. We're a little jealous of the AMD procedure – Intel's LGA processors have pins situated in the socket, rather than on the processor. To install it, lift up the retention arm on the right, carefully raise the bracket, and lower the processor into position. There are a few ways of aligning it, either with the processor's writing reading left-to-right (as below), or by the gold triangle on the bottom left of the processor. Once in place, lower the bracket down and under the Torx screw, before securing the tension arm back into position. The plastic cover will pop off and you're done.



03 All The Way Up To 11

We're not sure what a Lightning Gen4 M.2 slot is, but if it's anything like a PCIe 4.0 M.2 slot, then this thing is going to be super quick. The one big advantage we have over our AMD counterpart is that the Core i5-11600K supports PCIe 4.0 as standard, unlike the G series Ryzen chips. That may make it pricier, but the speed exerted by these drives is next level, and worth it for production work. To install our M.2 drive, we simply remove the two screws on either end of the topmost M.2 slot, lift off the heatsink, and then insert our M.2 drive into the slot, being sure to match up the notch with the drive. Then once in place, we peel off the protective film from the thermal pad, and place it back over the M.2 and replace those two screws.



04 Quiet!

Once the drive is in place, we move on to the DDR4. Unlock the clips at either end of the slots you want to use (alternate ones), then carefully slot our DIMMs into place, making sure to line up the notch on the bottom of the DIMM with the notch in the slot. Then it's on to the cooler. Be quiet!'s designs are always impeccable when it comes to providing ample cooling mixed with a hefty dose of style and the TF 2 is no different. This semi-low profile cooler comes with two fans (though we're only installing one) and is relatively easy to fit. We grab the Intel backplate and brackets, insert the standoff mounts, slot it through the motherboard, secure the two small brackets on the other side (remembering the plastic spacers). We apply a splodge of thermal paste to the processor, place the cooler on top, lining it up with the screw holes in the brackets, then secure it with a screwdriver.



05 Clean Installs

Next on the list was installing the motherboard inside the chassis. Now, admittedly, we had a bit of a problem here. The case has been used before. Sadly that meant that the accessory box was missing when we came to the build. A quick hunt around the APC studio hardware stash turns up a Phanteks screw box (the irony isn't lost on us), with just enough screws to secure the motherboard into position.

Laying the case on its side, we line the motherboard up with the stand-offs and then secure it in place with the correct screws. If you're planning on moving your system around a lot, make sure you install all of the screws. However, if it's just going to stay in your house, you can get away with doing four or five screws and it shouldn't be a problem.



06 Fan...tastic

We've skipped a step here visually, the power supply installation. In short, we secure the PSU in the back of the case, thread the cables throughout the chassis and plug them in. For this build, we need the 24-pin mobo power to the right, the 8-pin EPS (or CPU) power in the top left, and a SATA power at the back for the RGB fans.

Next, we install our front I/O headers, consulting our motherboard manual to find the correct position for the pins. Now, on to the fan, which can be tricky. We attach two metal clips to the sides of the fan, position it over the top of the cooler, then carefully hook the clips around the cooler. It pulls tight and keeps the fan in position and though it's not the most graceful solution, it's lightweight and doesn't impede airflow. Once it's on, plug in the fan cable to the CPU fan header on the board and we're done.



1 With no GPU and AIO radiator cooler, the rig looks clean yet we can't help feeling that it's a little empty.

2 If we were to do this build again, we would probably make the most of all the DIMM slots by adding another two sticks of 8GB RAM.

3 Thanks to the Phanteks' design, the rubber cable holes are in the perfect position to neatly feed our 24-pin and USB cables right to the mobo.

4 It would also be nice to add some lighting to the case. We're happy with how it works, but let's just say it's a bit bland.



1 Be quiet!'s Dark Rock TF 2 is a monster. We only installed one fan, but you could install a second one for extra airflow.

2 The MSI B550M is a great motherboard, with one major flaw – it lacks lots of fan headers. You could buy a fan-splitter cable to power two fans off one header.

3 With a 500W PSU tucked away under the floor here, there's plenty of headroom to install a GPU in the next two years once they become available again.

4 In this setup, the case is mainly positive pressure, but adding an exhaust fan would help keep internal temps cooler.

The conclusions

Sam Lewis: Piecing this machine together was a walk in the park. Fewer parts doesn't always equal easier, but Team AMD had luck on our side. No traditional radiator and cooler gave us more space to work with too. The case is large, but we love it. We know we said it wasn't about looks but if we were to rebuild, the RGB variant of this case would be a better choice – it's a bit empty in there and it needs a little something extra.

The only issue we had with this build was securing the CPU cooler onto the backplate, as it was a bit tight. We had to apply a bit of pressure to the backplate to get at least one screw in to finish the rest off slowly, go diagonally, take your time. Ideally, we don't want to put this pressure on the motherboard, but we also kind of needed the cooler. So, after some long hard thinking, we tried our luck.

After that, we had to get this thing up and running. With nothing coming up on our monitor, we knew we needed to update the motherboard's BIOS. Version

2423 was downloaded onto an empty FAT32 USB drive, we ran the renaming program, deleted the unnecessary files, and put it into the BIOS FLBK USB port on the back of the PC. Then we held the button down for a few seconds until it started flashing and let it do its thing. Once it booted, we loaded the Windows media creation tool onto another USB stick as per usual and got the OS installed too.

As a whole, this was a successful procedure with only a minor hiccup with some short screws. Not bad, right?

Zak Storey: I do love the smell of silicon in the morning. Especially when it goes pop. Actually no, it's the worst. That burning smell screams "dead hardware" and sadly on power-up, that's exactly what we experienced with this build. Just before the end of the shoot, we powered the PC on, just to see what it looked like with these three fans in the front of the case and, to our surprise,

nothing lit up. The power was on, the PC was running, but no light.

Fast forward five minutes, and a bit of fiddling around later, and still nothing. Then, silence. The PC came to a standstill, fans refused to spin, motherboard refused to light up. Nothing, no power-button wiggling, different kettle leads, or any of our usual tweaks helped. Then the smell arrived, that awful smell of burnt silicon, electricity, and water.

The culprit was discovered – a short-circuit on the RGB controller had burnt itself out, killing the power supply in the process. Fortunately, everything else was unharmed, but it just goes to show, leaving a once-tested case in a leaky, cold warehouse with an open box for a year, can sometimes lead to moisture build-up and eventual failure. Who knew? One new 500W power supply, and a lack of RGB later and we were good to go. You can have all the build experience in the world, but no matter what, there's always bound to be something that can catch you out. ■



Quick Tips

The problem solvers

The APC team field problems across the spectrum of devices and software. Learn a new trick or fix you can use.

Upgrade CPU for Windows 11

I have a self-built desktop based around an MSI X370 Gaming Plus motherboard and AMD Ryzen 7 1700 processor, with 32GB RAM plus a 500GB Samsung EVO M.2 NVMe boot drive and two additional 1TB SATA SSDs as storage. TPM 2.0 and Secure Boot are supported, and I successfully upgraded through the Microsoft Dev Channel to Windows 11 Pro.

I don't game, the system runs well and I'm happy with its performance. I enjoy using Windows 11 and would love to continue using it once it's released. The problem is that my system doesn't meet the system requirements of Windows 11, due to the first-gen Ryzen processor.

To pre-empt any problems that may crop up with the public release of Windows 11, I've ordered a Ryzen 7 3700x processor. I've already verified that my motherboard supports this processor and that I have the correct BIOS installed to support the processor.

My question is this: if I replace the processor, will that cause problems with my current OS installation? I'm not averse to having to do a clean install but would rather not if I don't have to. My system is completely stable, performs well, and even though I did an in-place upgrade through Windows Update, I see no compelling reason to do a clean install.

So, will a processor upgrade cause any issues that I should be aware of?
Bobby Sledge

APC Responds: Strictly speaking, swapping out your processor is much less disruptive than replacing your motherboard. In most cases, you should find your system happily accepts the Ryzen 3700x, but there's a small risk it could introduce some stability issues you can't easily resolve.

This is where taking a full drive image of your system using Macrium Reflect Free (www.macrium.com/reflectfree.aspx) takes the stress out of the process. Take your drive image, swap out the processor and see what happens. If you run into problems, swap the processors back, restore the drive image and then prepare to perform a clean install after refitting the new processor again.

Although clean installs are a pain, when you come to perform a major update like that to Windows 11 it's a good idea to consider wiping the slate and starting again, particularly if your current install is two or three years old. Our backup feature from APC October reveals various tools and strategies that you can employ, such as CloneApp (www.builtbybel.com/ms-apps/cloneapp), for backing up a wide range of program settings.

Malicious browser extension

You have previously tackled browser adware that won't go away even after a complete Windows reinstall. I had a similar problem in the past, which turned out to be my router. It was compromised, presumably by someone at my ISP, who had changed my router's primary DNS to a malicious one. A factory reset of the router solved that.

Micromantic

APC Responds: We've had a few suggestions from readers regarding Gerry Exstein's problem. Long-time subscriber Dennis Rudolph also pointed the finger at the router, suggesting a possible Wi-Fi hack. Again, a factory reset would fix this along with changing the Wi-Fi username and password. It's a good idea to change the router's default username and password too, as a weak password exposes the router to the dangers of remote hacking. Also, check for any router firmware updates or consider replacing the router with

a newer, more secure model.

Other readers pointed the finger elsewhere, and we suspect this is the more likely cause of Gerry's problem. Daniel Smith reported suffering a similar problem, which would only manifest after he'd launched Google Chrome for the first time after a reboot. Because Chrome keeps running in the background after being closed, the popups would then continue until Daniel either rebooted his PC or closed all chrome.exe processes via Task Manager. Daniel's workaround was to uninstall Chrome and switch to Firefox, at which point the problem vanished.

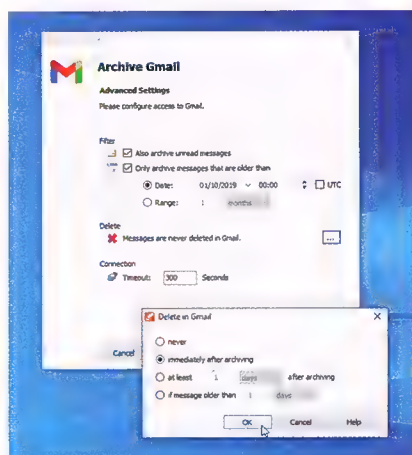
Daniel is still keen to troubleshoot the root cause of this problem, and a plausible explanation comes courtesy of a fellow reader, Jif. He points his finger at a malicious browser extension that keeps coming back, even after a full Windows reinstall via Chrome's profile sync feature.

The solution here is to review your Chrome extensions and plugins. Make sure you're signed into your browser profile and visit <chrome://extensions/> to see what's currently installed. Make a note of each, then click Details followed by 'View in Chrome Webstore' to review each one in turn, making a note of any reviews that should immediately flag up if the extension is malicious or not.

If in doubt, remove all extensions, allow your profile to sync, and see if that solves the problem; alternatively, switch to another web browser.

Sporadic wake problem

I'm having a sporadic issue: After waking my PC from sleep and completing login, my monitors lose their signals and I hear the fans quit. I can see that there's still power to the LED lights inside the case, but every other device seems to shut down, including the fans and an external drive. When I try to use the power button to restart, nothing happens – whether a simple push or push and hold for 30 seconds. I'm forced to switch off the power to the PSU and back on before the case power switch will start the system back up with the proper startup. This happens only about once every two or three weeks. I built this system about 2.5 years ago and the first time it happened was six



Free up online storage by archiving emails to MailStore.

Only first-gen
Ryzen processors
won't support
Windows 11.

months ago, but it is getting more frequent.

My system specs are: Asus Prime X470-Pro, Ryzen 7 2700, Zotac RTX 2060 AMP 6GB GDDR6, Trident Z RGB 16 GB (2x8GB) DDR4-3200 RAM, 970 Evo Plus 500 GB M.2-2280 system drive, plus 860 Evo 1 TB SSD for data. Power supply is an EVGA-SuperNova G3 750W 80+ Gold, all housed in a Corsair SPEC-02 tower and cooled with a Corsair Hydro Series H75 AIO. I'm running Windows 10 Home OES 64-bit.

Keith Hering

APC Responds: Our first instincts were that this was a hardware or physical problem. Keith verified that he didn't have fast startup enabled, and checking his event logs revealed no clues, leaving us to suspect the problem may be internal. Before pursuing potential problems with the PSU and motherboard, we asked Keith to power down his PC and investigate inside the case to rule out the possibility of loose metal objects (such as screws) creating a short somewhere. We also asked him to check all cables were securely tied back and connections were secure.

On opening his case, Keith discovered one hold-down screw that wasn't tight, which he rectified. And then he discovered the problem: his vent at the bottom of the case was clogged with dust from the carpet underneath his desk.

Keith cleared the dust away and built a 'hardware sled' to sit the PC on. Since putting the PC back together the problem appears to have been resolved. Fingers crossed it stays that way.

Gmail storage squeeze

I've never been the best at organising my email inbox, but never in my wildest dreams did I think I'd accumulate 15GB of messages. Google is telling me I need to free up space and I'm just too damned lazy to go through my inboxes. I could batch delete entire pages, but that would run the risk of me losing access to important emails from several years ago. How can I bring my Gmail under control with the minimum amount of fuss?

Kyle Jeffers



My question is this: if I replace the processor, will that cause problems with my current OS installation? I'm not averse to having to do a clean install but would rather not if I don't have to.

APC Responds: APC has traveled down the same road, Kyle, and the days of carefully combing through his inbox to remove or archive messages are long gone. That's partly down to laziness, but primarily due to the sheer volume of messages. Why? Because he has been using MailStore Home (www.mailstore.com/en/products/mailstore-home/) to periodically archive large quantities of email offline.

MailStore can be installed in the usual way, or follow our example and download the portable version, ensuring MailStore and all your emails are stored in a single folder, which you can then easily back up. Once downloaded and/or installed, launch the app and click 'Archive E-mail'. Type your email into the address field and click Start. MailStore will detect Gmail and whisk you off to your browser to link MailStore to your account.

Once done, a Gmail profile will be created, select this and click Properties... in the right-hand pane to open a wizard. Click Next to access the Advanced Settings, where you should tick 'Only archive messages that are older than' to set a target by date or range (such as six months or two years). Next, you need to click ... under 'Delete' to instruct Gmail to delete the messages once they've been downloaded to your PC - 'immediately after archiving' is ours choice. Click

OK followed by Finish.

Once set up, click Run. Depending on the size of your mailbox and the amount of mail you're archiving, the process can take several hours or even most of the day, so be prepared to leave it to its own devices. Once complete, go online and empty your Gmail trash to free up the storage space. Once archived, you can access emails directly from MailStore itself - use the left-hand pane to browse by folder or search your mail.

MailStore can also be used to return messages online if you need to - just right-click a message and choose 'Export to > Gmail', then follow the prompts to link up your account and send it back to the cloud.

Windows 11 sleep problem

In the previous issue, Phillip Tursky wrote in with a sleep problem that manifested itself after upgrading to the Windows 11 Insider Update build. We counseled him against pursuing Windows 11 on his 7th-generation system because it's not officially supported and suggested some options to try. Phillip has since been in touch to reveal that the CMOS failed, which he was able to fix by fitting a new CR2032 battery. He also took the opportunity to give his case a good clean and the problem has now been resolved. We're still not recommending running Windows 11 on unsupported systems though. ■



WINDOWS

How to fix an Inaccessible Boot Device BSOD

You get this stop code when Windows can't boot from your drive.

As its name indicates, the INACCESSIBLE BOOT DEVICE BSOD reflects some kind of issue with a Windows installation's designated boot device. When this error occurs, it means that the Windows file system tried to read the boot device and failed. Most often, this means the boot device failed to initialise.

Alternatively, when the boot loader attempted to access the designated boot device, it did not recognise its data as a file system structure. In simpler terms, the boot process did not find a bootable system where the boot configuration data said it was supposed to be. At the highest

possible level, this error indicates no boot device is known or accessible to the problem PC.

Common causes of Inaccessible Boot Device BSODs

Most of the time, the INACCESSIBLE BOOT DEVICE error occurs because a boot device has failed or is unreadable. During input/output (I/O) initialisation the boot device driver might not have been able to initialise the boot device (which is a hard drive or SSD). Other potential causes include:

- File system initialisation could not recognise the data

The Windows Preinstallation Environment (WinPE) on the Macrium Rescue Disk includes a general-purpose boot repair facility.

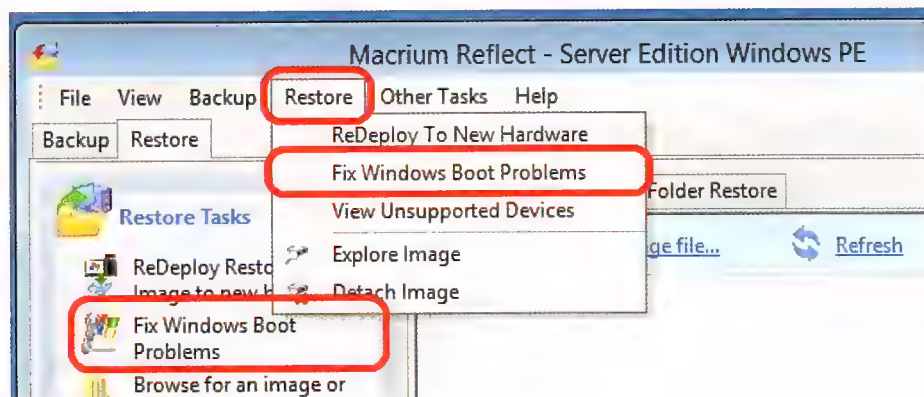
on the boot device.

- Device parameters for the boot device have become damaged, corrupted, or are invalid.
- If an error occurred during initial system installation, the OS may have been installed on an unsupported disk controller, or a valid driver for a non-standard disk controller may not be valid or available.

By far the most common situations when this error occurs, involve changes to the Windows boot environment of some kind. Repartitioning the boot/system drive, alterations to the boot configuration data (BDC), BIOS configuration changes, or installing a new or different disk controller can provoke this stop code, which takes numeric value 0X0000007B (aka 0X7B). This error code is discussed in more detail in the Microsoft Docs page for Inaccessible Boot Device (tinyurl.com/APC501BSOD).

Recovering from Inaccessible Boot Device errors

Sometimes, this error will occur as a one-time glitch. If that happens, some kind of transitory error interfered with one boot-up, but



Windows recovers on the next restart. If that happens on one of your PCs, be sure to make an image backup with some means to recover from bootable media if the problem recurs. I use Macrium Reflect Free to make daily image backups; that program's bootable Rescue Media on a USB Flash drive offers an alternate boot, and can restore the most recent image backup to my boot/system disk any time it's needed.

In fact, that bootable Rescue Media also includes a "Fix Windows Boot Problems" option that I have used many times to repair boot issues. It's adept at fixing boot errors that may pop up when editing or altering boot menus or boot configuration data.

Microsoft's repair advice for INACCESSIBLE BOOT DEVICE also includes the following recommendations:

- Revert recent hardware changes: If you've recently added or changed system hardware – especially disk drives or related drivers or drive controllers – remove them from the system. Often this will immediately fix what's wrong because the boot drive order can be affected in the aftermath of such changes. If this fixes the problem, you'll need to make configuration changes to resolve potential IRQ or I/O port conflicts to get all parts working.
- Undo BIOS changes: If you've reset boot order or drive priority improperly, restoring previous settings will usually set things right. This stop code may pop up, for example, when changing controller mode from legacy to AHCI, or from RAID to AHCI (or vice-versa) in the BIOS.
- Check storage device compatibility: If you've added a new storage device or controller, you must check to make sure it's compatible with Windows. If you've added a controller, make sure the driver is compatible with your Windows version. It might be a good idea to try a fresh download from the maker or OEM, just to be sure the driver is not damaged or corrupted.

Bottom line on Inaccessible Boot Device errors

In the vast majority of cases, the INACCESSIBLE BOOT DEVICE error will get resolved when you undo your most recent system changes. In a few cases, though, you may not be able to get Windows to recognise a boot device through any of the preceding fixes. If that happens you have no choice but to perform a fresh, clean install of your specific Windows version. And if that doesn't work, your drive could be physically damaged.

You may also have to forgo new drives or controllers if you are unable to make them work, even under such a clean install. In my 30 years' working with Windows this has never happened to me, but one does read about such things online occasionally. Through trial and error, and working with known, good and compatible hardware components, you should be able to put a working Windows configuration together, even in the face of such problems. ■



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GENIUS TIP

Instead of using Time Machine to back up VMs, copy them when they're shut down at night, using a utility like Carbon Copy Cloner.



APPLE MAC

Run a virtual machine

The best way to run Linux or Windows on an M1 Mac for the present.

IT WILL TAKE
20 minutes, plus
download time

YOU WILL LEARN
How to install and use
virtual Ubuntu Linux

YOU'LL NEED
macOS 10.13 or later,
Parallels Desktop 17
(\$109.95, [parallels.com](https://www.parallels.com))

Intel Macs can run Windows in Boot Camp, but there's no equivalent on Apple silicon Macs, where the best way to run Windows or Linux is in a virtual machine (VM) in Parallels Desktop.

Until the release of Windows 11, running that or Windows 10 on an M1 requires you to join

Microsoft's Insider Program to gain access to pre-release versions for ARM systems.

Fortunately, Linux is simpler, as Parallels offers four different distros for ARM systems, including the excellent Ubuntu. Until native Asahi Linux ships, that's the best way to run Linux on your M1.

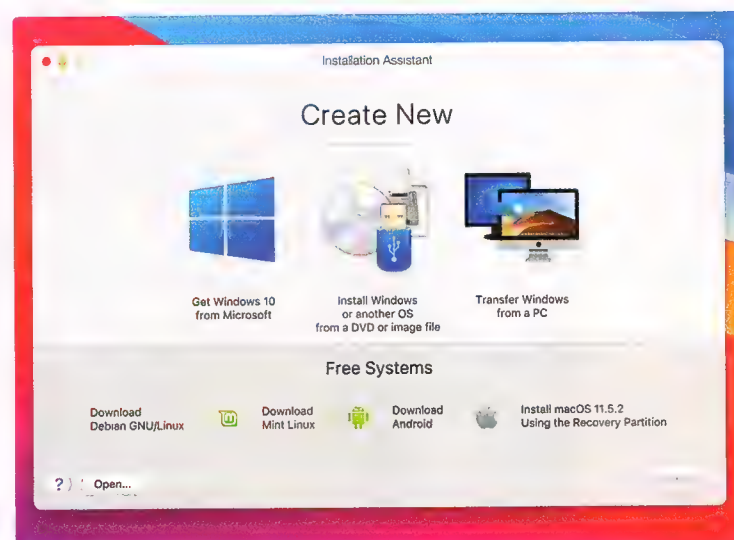
Intel Macs have a far wider choice of many different versions of Windows, half a dozen easy-install Linuxes, Android, and all versions of macOS from 10.7 to Monterey.

Easy installation

In each case, installing the VM is similar: download the right distro for your type of Mac and run its installer in the VM. This is most straightforward when Parallels already offers to do that in its Installation Assistant.

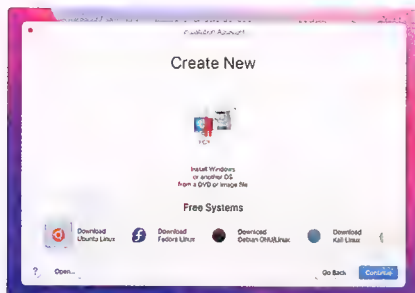
Once your VM is up and running, Parallels Tools then shares the folders in your Home folder, making it easy to transfer files, and integrates your guest operating system with copy and paste, and your Mac's hardware, including networking and printers. What you end up with is the best of both worlds without the need for any additional hardware, and you can tune VM performance to your needs.

HOWARD OAKLEY



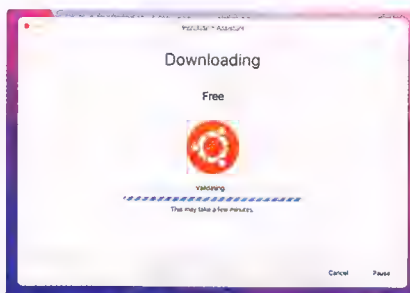
There are far more operating systems available to Intel Macs, including many versions of Windows and macOS.

HOW TO Run a virtual machine with Parallels Desktop 17



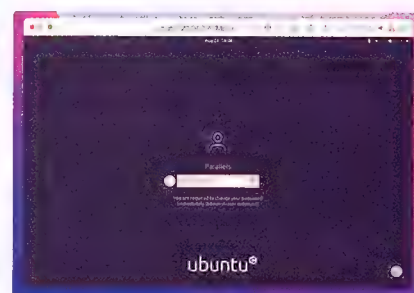
01 Download Linux

Open Parallels Desktop, and set up its extension and privacy when invited. If necessary, use the File/New command to open Installation Assistant. Select Download Ubuntu Linux at the lower left and click Continue.



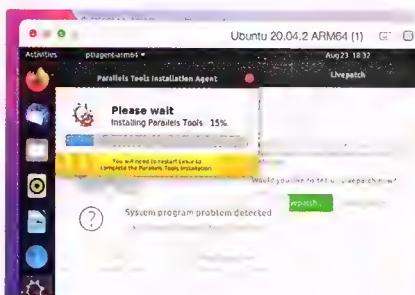
02 Install Linux

When you create the first VM, Parallels will ask to create a VM hard disk image. Agree, and the 2GB Ubuntu installer will download and then be verified before it automatically installs into the new virtual machine.



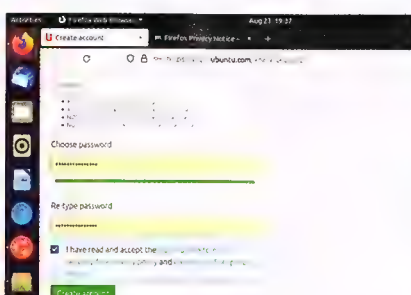
03 Log in

The window then fills with details as it progresses, after which it boots the VM into Ubuntu Linux and presents the login screen. Click on the Parallels user and enter a new password, re-enter it, and Linux opens.



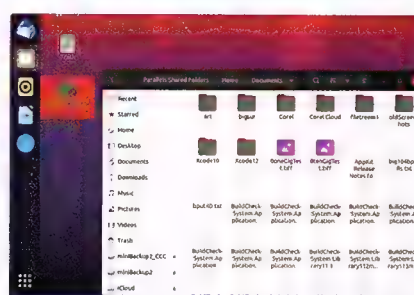
04 Install Parallels Tools

Enter your password to start Parallels Tools installation, then agree to restart the VM and log back in. Ignore any system program problems which might be reported, and decide whether to set up Livepatch as offered.



05 Set up Livepatch

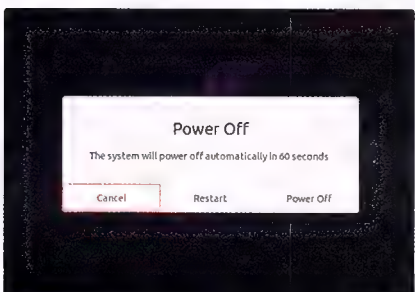
For Livepatch, follow the instructions to set up a Canonical account. Collect your email response from your macOS mail client, copy the link from there and paste it into Firefox in Linux to complete the setup process.



06 Access shared folders

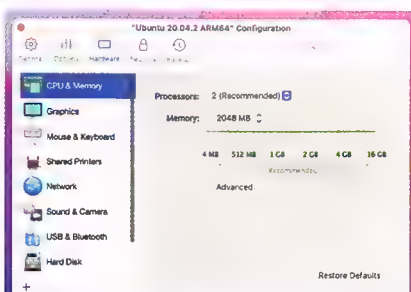
Access shared folders

With Parallels Tools, the VM shares your macOS Home folders, making it simple to transfer files between systems. To access those in your VM, open Parallels Shared Folders on its Desktop, which includes iCloud Drive.



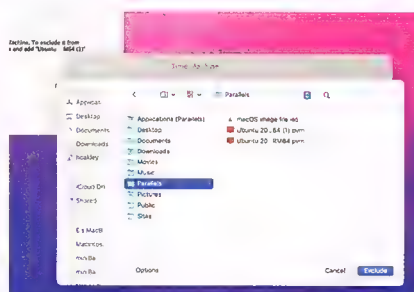
07 Shut down VM

To access Linux apps, use the icon at the bottom left of the window. To configure its settings, shut it down using the Power button on the right of the Linux menu bar. It briefly displays another stream of text.



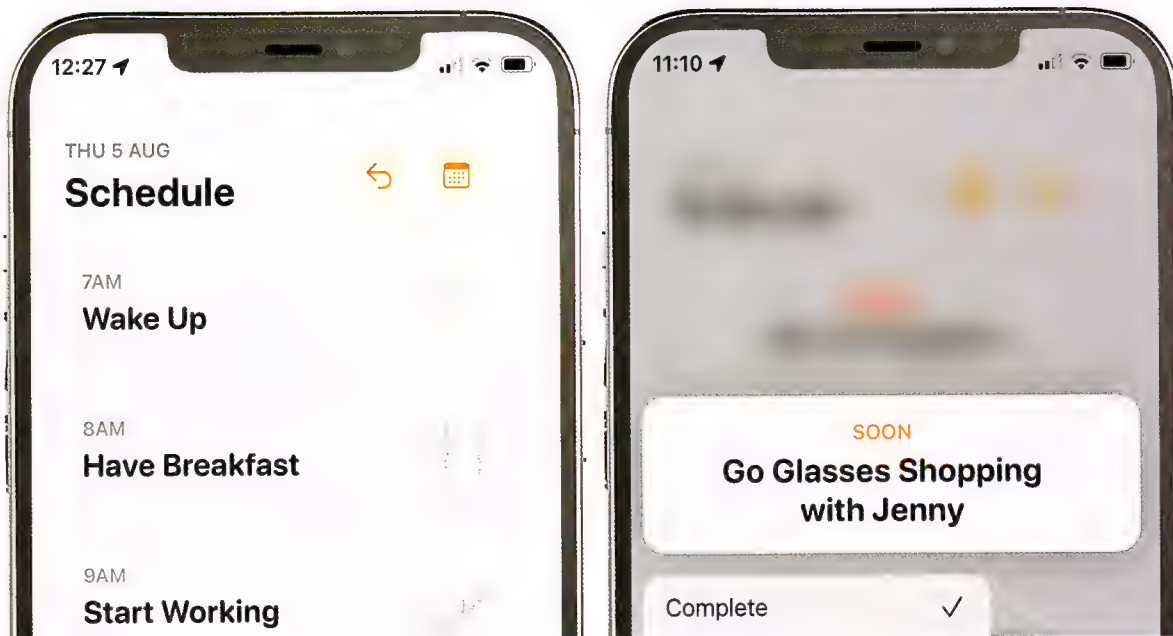
08 CPU & Memory

In the Parallels menu bar tool, open its Control Centre. Click the gear icon on the VM you want to change settings for. In CPU & Memory of the Hardware tool you can adjust cores and memory to tune VM performance.



09 Exclude from backups

Select the Backup tool and Open Time Machine Preferences, agreeing to let Parallels have access to the pane. Click the Options button and locate the Parallels folder in your Home folder. Add that to the exclusions. ■



APPLE iOS

Plan your day on iOS

Get on top of your tasks with Hour Blocks' daily schedule.

IT WILL TAKE
10 minutes

YOU WILL LEARN
How to plan daily tasks and create a schedule

YOU'LL NEED
Hour Blocks (free), iOS 14 or later

Getting organised is a lot easier said than done. If you've ever tried to plan your days out but found yourself overwhelmed with everything that seems to be on your plate, you will know how hard it can be.

Instead of showing a calendar view packed with events, the Hour Blocks app focuses on one day at a time.

Each day is broken down into a timeline with hour-long slots, with one task for each block. This gives you a clear, uncluttered way to view your schedule that lets you focus your energy where it matters. The more you use Hour Blocks, the smarter it gets, learning from your habits and suggesting appropriate activities at the right time of day. It's simple

enough to be unobtrusive, but has enough power to keep you in control.

As well as being available on iOS and iPadOS, there is also an Hour Blocks Mac app for when you're not using your iPhone or iPad. Each app is totally free, with all features readily available.

ALEX BLAKE

HOW TO Plan with Hour Blocks

WED 14 JUL

Schedule



ALL DAY

Tutorial: Plan your day with Hour Blocks

7:30PM TO 10:00PM

Web design course

Suggestions

POPULAR

Work



POPULAR

Lecture



01 Grant access

When you first open Hour Blocks, grant it access to your calendar and it will add events to your timeline automatically. If there are no calendar events for a selected day, the Hour Blocks schedule will be blank.

02 Add events

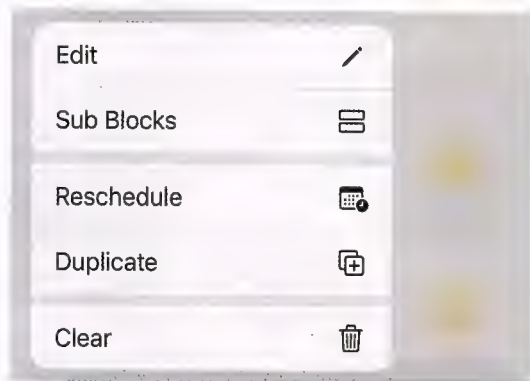
Add events by tapping the '+' next to an hour slot. Pick a suggested activity or insert a title in the text box and tap '+' to add it. Tap the calendar to plan a different day, or swipe sideways at the top of the schedule.

GENIUS TIP!

Hour Blocks' to-do list works with Siri. Try saying, "Add gardening to my to-do list in Hour Blocks." (The task may not show right away.)

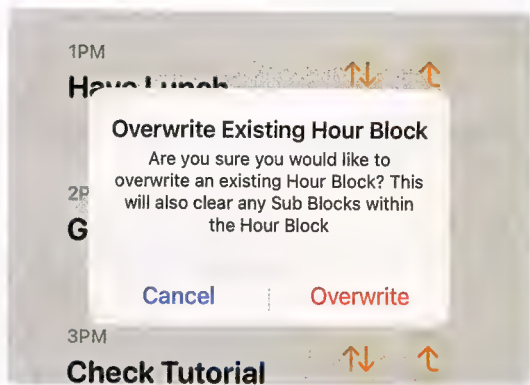
Start Home Renovation Plans





03 Block options

Tap and hold a block in the schedule to see its options. You can edit its name and icon, reschedule it to a new time in the day, duplicate it, or remove it from your timeline. Tap anywhere outside the menu to close it.



05 Reschedule your work

Tap and hold a task, then tap Reschedule. Tap the icon with an up/down arrow to swap this task with the one you long-pressed. Or tap the single up or down arrow to overwrite this block with the one you long-pressed.



Add a To Do Item

Start home renovation plans +

..

07 To Do List

Tap To Do List at the bottom. Tap the '+' to add a new to-do task, enter a title, select its urgency, then tap '+'. Tap and hold one to add it to your timeline or complete, edit, or delete it. These tasks are ordered by urgency.

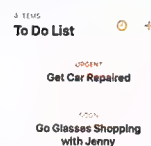
START WORKING ON TUTORIAL

Plan tutorial steps



START WORKING ON TUTORIAL

Pick a template



GENIUS TIP!

Hour Blocks' To Do List isn't like a reminders list – there are no due dates or alerts. Use the Reminders app for more important tasks.

04 Sub blocks

The long-press menu lets you add sub blocks to a task. This is handy if your main task is made up of smaller steps, such as tidying the house or starting a piece of work. Remove sub blocks by tapping the bin icon.

Duplicate Hour Block

6AM
Empty +

7AM
Wake Up

06 Duplicate a task

Some tasks take longer. For these, tap and hold the task, then tap Duplicate. From the menu, tap the '+' next to every hour block that you want the task to cover. This can quickly populate your day if needed.

Other Stuff

Reminders

Enable reminders for upcoming Hour Blocks (changes only applied to new Hour Blocks)

Yes

No



08 Adjust settings

Tap Settings at the bottom to tweak how Hour Blocks works. Here, you can choose which calendars are imported, whether you get sent Hour Blocks reminders, what time your day starts, and even change the app icon.

GENIUS TIP!

Hour Blocks has four widgets you can add to your iOS Home screen: your upcoming schedule, and your to-do list, each in two different sizes.



Backups aren't just a safety net for Trekkies such as Shashank Sharma, but a way of life. But they can take up quite a lot of space if not done right.

Backup tools for Linux are as prolific as browsers, video players or even text editors, BorgBackup, or just Borg, is a deduplicating backup utility. Released under the BSD license, the project was forked from Attic, a popular backup utility, in 2015. Thanks to the data deduplication technique, Borg is suitable as an everyday home or even enterprise backup solution, with a host of features that make it a breeze to use.

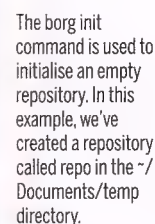
The Borg are good!

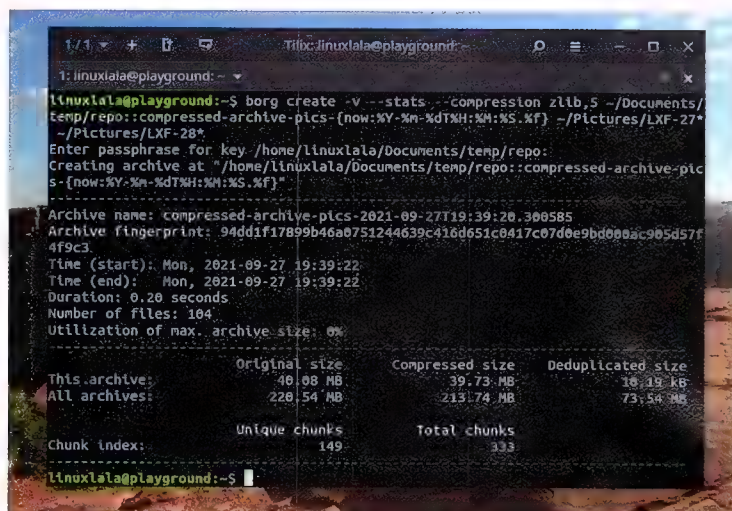
desktop distributions. The project's website, however, cautions that the repositories might not always carry the latest version. Thankfully, the current release, version 1.1.17, is available in most popular distributions such as Fedora, Ubuntu, Debian, Mageia, Arch, openSUSE Tumbleweed, and others.

As can be expected, the project has a long list of dependencies, so if you decide to compile it from source, please carefully follow the installation instructions on the website. Just the thorough focus on installation make Borg one of the best documented command-line tool we've encountered.

Borg has various sub-commands such as **create**, **init** and so on, and each has its own set of arguments. Thankfully, you can access help using the **borg command -help** command, or from the website. To create a repository, you must run the **borg init PATH** command. The project recommends that you use encryption to safeguard your data. Use the **-e none** option if you don't

The main website of the project is <https://borgbackup.org>. You can access the official documentation at <https://borgbackup.readthedocs.io>. The main website also provides links to free resources as well as commercial support and services around Borg.





wish to use encryption. Alternatively, you can choose from between using a passphrase only, or passphrase and key encryption.

The `borg init -e passkey /path/to/repository` command will prompt you to enter a passphrase. The repository created with the `init` command will be protected by the passphrase. You will not be able to access the repository, add backup files to it, or restore data from it without the passphrase.

Learn to live with the Borg

Once a repository is created, Borg is now ready to accept files. Each backup is stored in a unique archive within the repository. You can create many repositories and archives with Borg. For instance, you could create a repository to backup PDF files from work, and another repository to backup music sheets. You must use the

`borg create /path/to/repo:archive_name /path/to/data` command to create a new archive within the repository:

```
$ borg create ~/Documents/temp/repo::first-archive ~/Documents/APC-submissions ~/Pictures/for-APC/
```

In this command, we've created a new archive called `first-archive`. Borg will recursively traverse through the specified directories and add files to the specified archive. When we create a follow-up archive, only new content from these directories is added to the archive:

```
$ borg create --stats ~/Documents/temp/repo::second-backup ~/Documents/APC-submissions ~/Pictures/for-APC/
Enter passphrase for key /home/linuxlala/Documents/temp/repo:
Creating archive at "/home/linuxlala/Documents/temp/repo::second-backup"
```

```
Archive name: fifth-backup
Archive fingerprint: c4ce413d82e4d00b9b4defdf8eadd
c8af674059a8044aac905e00c527c8224d8
Time (start): Mon, 2021-09-27 18:33:14
Time (end): Mon, 2021-09-27 18:33:14
Duration: 0.19 seconds
Number of files: 10
Utilization of max. archive size: 0%
```

	Original	Compressed	Deduplicated
This archive:	35.43 MB	33.91 MB	2.39 kB
All archives:	140.38 MB	134.28 MB	33.80 MB
	Unique chunks	Total chunks	
Chunk index:	38	115	

When creating an archive, you can timestamp the archive for smarter filenames. This is more efficient than numbering your backups manually.

Refer to the last column in the Deduplicated size. This tells you that the archive only has 2.39K of new data, as all the other data in the specified directories is already part of another archive.

Mount and extract archives

As its name suggests, you use the `borg extract` command to extract data from an archive. By default, Borg will extract the entire content of the specified archive, but you can choose the data you wish to extract using the `--exclude` option, or even the `PATH`.

Using our previous example where we created an archive of two directories `~/Documents/APC-submissions` and `~/Pictures/for-APC/`, we can extract all the image files using either pattern matching or the directory path:

```
$ borg extract ~/Documents/temp/repo::first-backup ~/Pictures/for-APC
```

Enter passphrase for key /home/linuxlala/Documents/temp/repo:

You can similarly use the `--exclude` command option to restrict Borg:

```
$ borg extract ~/Documents/temp/repo::fifth-backup --exclude '*.odt'
```

Enter passphrase for key /home/linuxlala/Documents/temp/repo:

The `borg mount` command can be used to mount an archive. First create a mount point for the archive:

```
$ mkdir /tmp/backup
$ borg mount ~/Documents/temp/repo::second-backup /tmp/backup
```

You can now open the `/tmp/backup` directory in your favourite file manager and look through the contents. Be sure to unmount the archive with the `borg umount /tmp/backup` command after you're done.

You'll also appreciate the `borg diff` sub-command, which can be used to compare the contents of two archives. The `borg diff ~/Documents/temp/repo::second-backup third-backup` command will inform you of all the changes between archives.

There's plenty more you can do with Borg. Thankfully it's an excellently documented utility and you'll find all the information you need in help pages for each of the sub-commands, or on the project's website, to truly understand the full capabilities of Borg. ■

COMPRESSED ARCHIVES

When creating a new archive, you can also use the `--compression` or the `-C` command option to create a compressed backup archive. Borg defaults to using LZ4, which is fast but offers little compression.

Borg also supports other compression algorithms such as `zstandard`, `zlib` and `lzma`. You can use a mix of compression algorithms for different archives within the same repository. This is because deduplication is done on the source data chunks.

With the exception of the default LZ4, all other algorithms expect a compression level. For `zstd`, the compression levels range from 1-22, while for `zlib` and `lzma`, the options are 0-9. `borg create --compression lzma,4 repo/path::archive-name data-sources` creates an archive using the `lzma` algorithm.

You can also direct Borg to decide for itself whether the data needs to be compressed or not. This is done with the `auto` command option. Borg attempts to use the `lz4` compression on each file, and should the file be compressive, uses the defined compression algorithm and level:

```
$ borg create --compression auto,lzma,4 repo/path::archive-name data-sources
```

Borg will first test each file's compressibility using the `lz4` algorithm. If the file can be compressed, Borg will compress it using the `lzma` with level 4.

RASPBERRY PI

Turn your Raspberry Pi into a cloud server

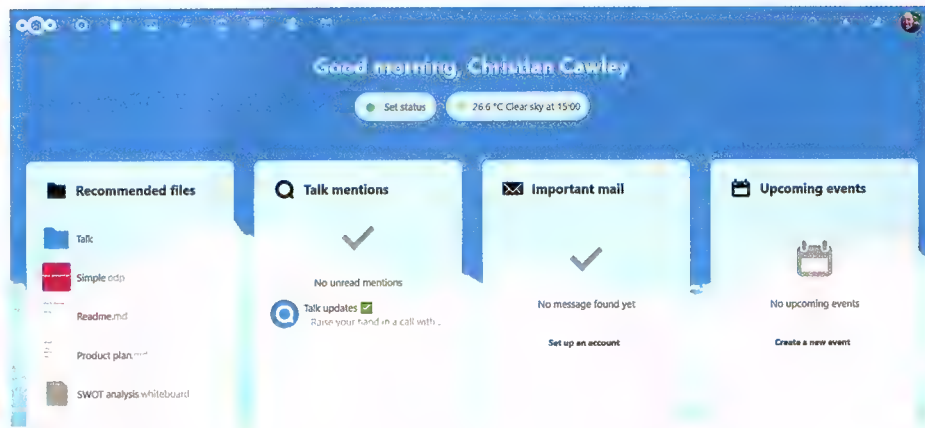
Christian Cawley has had enough of third-party cloud storage. Is a nextCloud-powered cloud server on Raspberry Pi the solution?

Staying in control of your own data is vital. It goes deeper than personal data, too. All of those files and folders in your personal cloud storage with Google Drive, Dropbox, Box, Microsoft OneDrive and many others are subject to various degrees of – let's say oversight – that you might not be entirely comfortable with.

The solution is to run your own cloud server: a home-based storage system that can be accessed from anywhere. Available 24/7 for syncing data across your devices, mobile and desktop, such a server is best connected directly to your router for reliability. And you can do this with a Raspberry Pi and a suitably sized storage device. While several projects are available for building your own Raspberry Pi cloud server, perhaps the most complete solution is Nextcloud.

If you're sick of paying for cloud storage or just find the whole idea a bit suspicious, self-hosting your own always-accessible cloud makes sense. With your own hardware and hosted on your own network, the cloud will be completely private. Throw in optional VPN support and even encryption to improve privacy. Self-hosting is also cheaper. For example, a 2TB drive on Amazon is considerably cheaper than the same level of storage with Dropbox or Box.

Rolling your own home-based cloud storage solution will also



give you faster speeds. You don't need to rely on internet connections and put up with online traffic and virtual server bottlenecks. The cloud is hosted on your own network, which means that you can sync data based on your router's Ethernet or Wi-Fi speed.

Nextcloud solutions

Several cloud servers are suitable for Raspberry Pi. These include ownCloud, Nextcloud and Seafile. You can even do the whole thing from scratch with the Pi Cloud system, installing various server and VPN software to create a barebones cloud solution on Raspberry Pi OS.

Nextcloud has been chosen for this build. It comes with two installation options, configuration

With Nextcloud running on your Raspberry Pi you can enjoy a self-hosted cloud storage, collaboration and productivity tool.

Rather than leave a bare Raspberry Pi hosting Nextcloud on a table top, use a case with built in cooling and space for either a SATA HDD or SSD.

is clear rather than esoteric, and it's open source. When used on your own hardware, Nextcloud is also free to use.

There are three main options for installing Nextcloud on Raspberry Pi: the NextCloudPi image, the Nextcloud Ubuntu appliance for Raspberry Pi, and manually installing on an existing Raspberry Pi OS installation.

While a Raspberry Pi 3 can be used, it's considerably slower than a Raspberry Pi 4. As such, the later Pi is recommended, with at least a 4GB SD card – 128GB cards are around \$50. We ran NextCloudPi on a Raspberry Pi 4 with 8GB of RAM and a 32GB SD card. You'll also need a monitor and keyboard attached for the initial setup, although these can be detached, and the server ran as headless after configuration. Ethernet is recommended for speed and reliability.

Get your Pi in the sky

You can take your pick of methods for installing Nextcloud on Raspberry Pi. NextCloudPi is a preconfigured Nextcloud image for Raspberry Pi (and other SBCs) that features everything you need to manage your own cloud data server.

Built with Debian Buster and Nextcloud 19.0.2, NextCloudPi has a setup wizard, web interface, dynamic DNS support, USB



automount and everything else you might need to run a cloud server. It also supports Nextcloud mobile apps for mobile data syncing.

NextCloudPi also offers a choice of installation options. You can install it the usual way, as Etcher, then move the image to a USB; or use a Raspberry Pi Imager or a Raspberry Pi OS installer to flash the image to the SD card. This guide is concerned with the use of a Nextcloud standard SD card installation using the Raspberry Pi Imager.

If you're installing Nextcloud Pi, click Choose Raspberry Pi OS to select the downloaded IMG. Choose Storage to select your SD card, then Write. After flashing, boot the SD card in your Raspberry Pi and login with the Raspberry Pi OS default credentials, these should be changed as soon as possible.

To use wireless networking, enter `sudo raspi-config` and choose 2 Network Options. Select N2 Wireless LAN and choose the correct country, then enter your router's SSID and password. Next, go to 5 Interfacing Options and enable SSH.

Exit `raspi-config`, then make a note of the IP address for wlan0 with `ip addr`. You can then access the Nextcloud server via SSH from another computer using `ssh pi@<YOUR IP ADDRESS>`

The Pi can then be disconnected from the display and monitor at any point now.

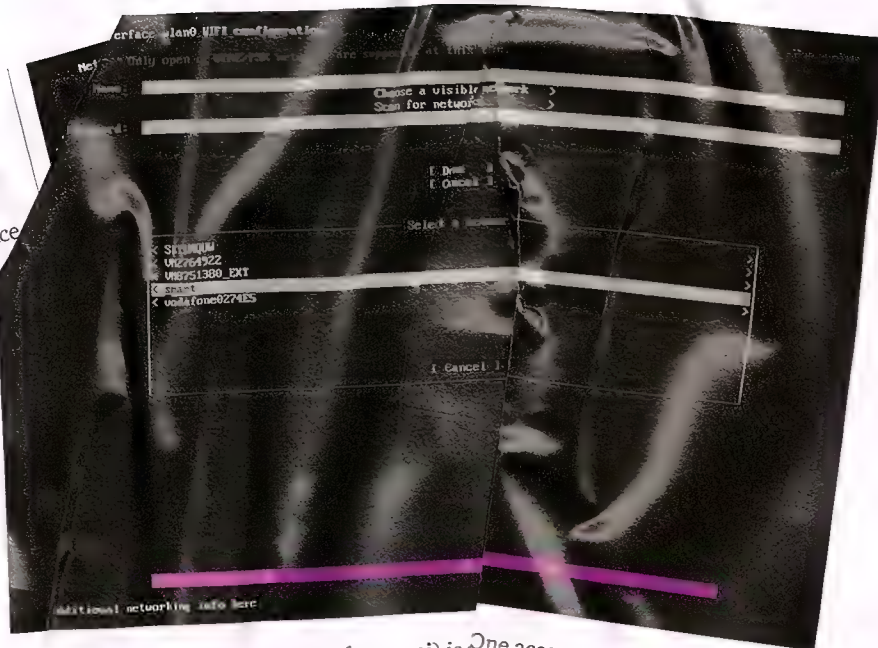
Either directly in the terminal or with an open SSH connection, enable the Nextcloud web interface:

```
sudo ncpi-config
```

Select CONFIG then scroll to nc-webui. Erase the no and type yes instead, then Enter. Go Back, then Finish to exit. From your main computer, open `https://<YOUR IP ADDRESS>:4443` in your browser, using the Pi's IP address where specified. Login with the username `ncpi` and the password `ownyourbits`. Copy or note the passwords for the web configuration panel and the main web interface, then click Activate. To use the Nextcloud web interface, open `https://[YOUR IP ADDRESS]`.

Ubuntu Appliance

Using Ubuntu Appliance (<https://ubuntu.com/appliance/>)



Correct wireless configuration enables you to place your Raspberry Pi Nextcloud appliance anywhere in your home or office.

Quick tip

You can sync calendars to Nextcloud, but don't expect too much from large multi-event calendars spreading several years. These tend not to be imported successfully. It's smarter to start a new calendar in Nextcloud where practical.

One account, then click Import SSH Key to save it. On the Raspberry Pi, tap Enter when prompted. The next step is to configure networking. With Ethernet connected, simply move on to the next screen by highlighting Done with the arrow keys and tapping Enter. If you're using Wi-Fi, (single sign-on) and store encryption keys for SSH. Next, input your Ubuntu One email. Shortly after, the account should be verified and the IP address of your Nextcloud server displayed.

While this starts up, copy your Ubuntu One account keys and tapping Enter. If you're using Wi-Fi, (single sign-on) and store encryption keys for SSH. Next, input your Ubuntu One email. Shortly after, the account should be verified and the IP address of your Nextcloud server displayed.

Along with the IP address, you should see your Ubuntu One SSO keyname. This can be used to access the Nextcloud server over SSH, in Windows user the style: `username@<YOUR IP ADDRESS>`.

Full access can be enjoyed via the browser. Using your main computer, open `http://nextcloud.local` in your browser (or the IP the SSH Keys

SYNCHRONISE

Yx replacement is unsurprisingly straightforward. It starts with an admin account! You wouldn't use an admin account! You begin configuring things to behave like you can then login to the app.

Take image syncing from Google Photos to stop you from losing important family and personal photos. You'll find an easy menu item to enable this Tap Menu > in prompted. Syncing will then

want to sync, then allow creation of folders, new text documents, and even you might sync a KeePass database with your computer, and decide whether to use virtual files, s





address displayed on your Raspberry Pi). Upon first access you'll be prompted to create a server administrator account. This is vital for the administration of Nextcloud server, enabling you to configure user access.

Terminal install

If you prefer to use your own Raspberry Pi OS for Nextcloud, it can be installed and set up in a terminal. Raspberry Pi OS Lite (tinyurl.com/APC501netcloud) is recommended for this.

Prerequisites for this approach are the installation of the Apache, PHP and MySQL, along with the PHP modules:

```
sudo apt install apache2 mariadb
libapache2-mod-php
sudo apt install php-gd php-jpeg
php-mysql php-curl php-mbstring
php-imagick php-xml php-zip
Next, open the web folder:
cd /var/www/html
Check the download path:
(tinyurl.com/APC501netcloud) for the version of Nextcloud you plan to use.
sudo wget https://download
```

```
com/server/releases/nextcloud-xx.x.x.zip
When the download has completed, extract with:
sudo extract nextcloud-xx.x.x.zip
With this done, configure folder permissions:
sudo chmod 750 nextcloud -R
sudo chown www-data:www-data
nextcloud -R
```

This ensures that anyone with an account can access your Nextcloud. You can then set up the MySQL database:

```
sudo mysql
CREATE USER 'nextcloud' IDENTIFIED BY 'password';
CREATE DATABASE nextcloud;
GRANT ALL PRIVILEGES ON nextcloud.*
TO 'nextcloud'@localhost IDENTIFIED BY 'password';
FLUSH PRIVILEGES;
```

CLOUD IN A CASE

If you're running the Raspberry Pi with a hard disk drive or SSD attached, it makes a great case. Various Raspberry Pi cases are available, some with the Pi as a data server.

Perhaps most popular, which provide space for a Raspberry Pi 3, so features an internal 30mm fan and aluminium casing.

Meanwhile, the Argon One enables you to connect superfast M.2 SSDs to the Pi Pro. This is equipped with board-level cooling, one of the same features active on the Pi 4.

An alternative, if you want any sort of cooling, one of the WDLabs PiDrive kits is simple: keep your Pi and HDD connected to the

Rather than a bare Raspberry Pi, hosting Nextcloud on a table top, use a case with built-in cooling and space for either SATA HDD or SSD.

quit. You should now be able to access the Nextcloud server from a desktop browser using the IP address of your Raspberry Pi, <IP_ADDRESS>.

Changing the account

With Nextcloud on the Raspberry Pi, connect to it from your network (or a static IP address if you use a tool like No-IP or a dynamic DNS service). There's even a mobile app for Android and iOS that can be used to sync files from your phone to the Pi-powered Nextcloud. If you don't use the Play Store, the Android Nextcloud app is also available on F-Droid.

In the browser-based interface you'll find a bunch of menus, presented like a cross between a smart TV and a typical cloud storage UI. From here you can upload files manually from your computer, or via a client tool – available for Linux, macOS and Windows. While command line configuration options are available, everything you need to manage your Nextcloud is available in the browser.

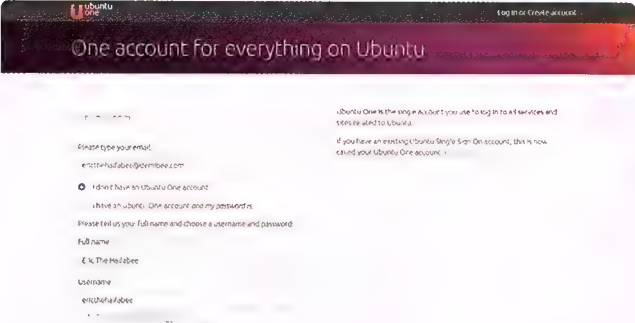
Beyond the default photos, files, contacts, calendar and various other productivity tools, Nextcloud can give you almost anything you need via a collection of programs. Some of these are preinstalled, others can be added in the Apps screen. This covers everything from tools like Collabora Online to new themes, social network integrations, and much more.

To find out more, it's worth taking the time to follow this tutorial with your preferred Nextcloud installation method and explore what's available. Nextcloud has evolved into a vast and impressive cloud productivity environment. Consequently, this guide only scratches the surface of what is possible with Nextcloud on a Raspberry Pi. ■

Quick tip

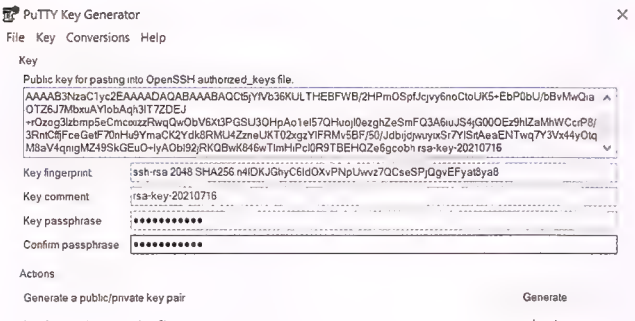
Connecting a USB hard disk drive will increase storage for your Raspberry Pi-powered Nextcloud server. A case with space for an HDD is a smart idea, too, such as the DeskPi Pro or Argon ONE.

HOW TO Generate an SSH key for your Raspberry Pi Nextcloud Ubuntu Appliance



01 Create an Ubuntu One account

The Raspberry Pi Nextcloud Ubuntu Appliance requires an Ubuntu One account to operate. This ensures a secure, encrypted connection to verify your Ubuntu One login to the appliance. To start, open your Ubuntu One account or create one if you don't already have one (see <https://login.ubuntu.com/>). Once verified with a valid email address, log in to the account and click the SSH Keys link in the menu.



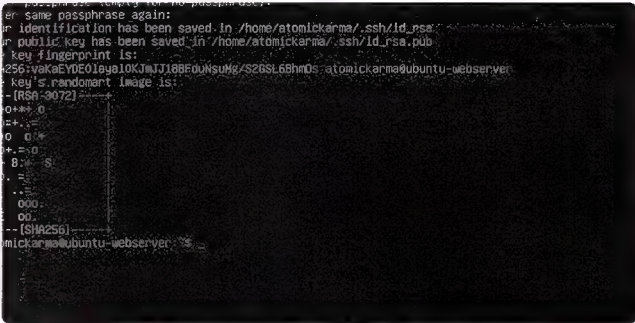
01 Create an RSA-SSH key in Windows

If you're using Windows, key creation requires extra software. Download and install WinSCP (<https://winscp.net/eng/index.php>) and in the Login screen click Tools > Run PuTTYgen. Here, ensure RSA is selected at the bottom, then hit Generate. Move the mouse when prompted, then input and confirm a passphrase. Use either of the save options to store the key in a dedicated file on your



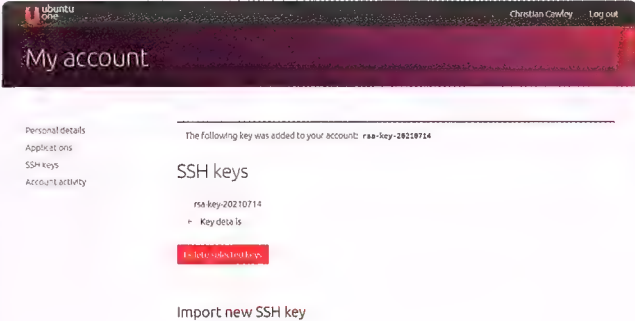
03 Access your Ubuntu One account in Nextcloud

To conclude secure single sign-on (SSO) authentication of your Raspberry Pi Nextcloud Ubuntu Appliance on first boot, tap Enter when prompted and then log in with your Ubuntu One account credentials. A few moments later, authentication should be complete. If not, tap enter to try again. If the network connection is reliable, it should go through.



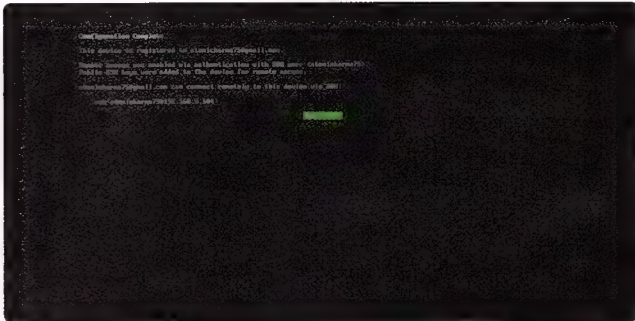
02 Generate the RSA-SSH key

An SSH key must be created. On your Linux computer, open a terminal and enter: `ssh-keygen -t rsa` This will create a new SSH-RSA key that you can save to your computer. Press Enter to select the default location. You'll need to supply the file path to the desired location if this is different to the default option.



02 Paste the RSA-SSH key into Ubuntu One

Copy the generated SSH key from your terminal or text file. On your Linux setup you can retrieve this with the following command: `cat ~/.ssh/id_rsa.pub` On your Windows machine, simply open the text file and copy the key string. Then, on the Ubuntu One website, paste the key into the field labelled Public SSH Key and click Import SSH Key.



04 Connect to the Nextcloud Ubuntu Appliance

With the account authenticated for SSO, you can use the same credentials to access the Nextcloud configuration options over SSH. This affords several options including managing external USB drives. You can use the passphrase you created with the SSH-RSA key to authenticate the SSH connection. Connect using `ssh username@<IP_ADDRESS>` then enter the passphrase.

Big changes coming to Intel CPUs

Intel is changing the way it makes CPUs – and it's something you've probably seen before. Darren Yates explains.

Get ready to hear plenty about 'Alder Lake'. It's the codename for Intel's new 12th-generation 'Core' processor series, which is set to make waves, not least for its use of heterogeneous cores. This month, we explain what this means, why it's a great idea and why you've probably already seen it in Android and Apple devices.

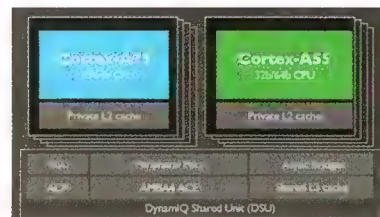
One core can't rule them all

It sounds easy enough – develop a CPU core that goes like the wind but thrifty enough to run for days off a battery. The only problem is that given current technology, it can't be done – well, not to the extent that we'd all like.

When Intel bolted two Pentium 4 CPU cores together inside a chip and called it the 'Pentium-D' back in 2005, I remember it being one of the hottest chips (thermally) I'd ever tested. The following year, it released its then-new 'Core' CPU range, offering more efficient multi-core processing and Intel has been riffing on this architecture line ever since. The problem with it, however, is that while you focus on performance, you can't fully consider power efficiency. Sure,

DynamIQ big.LITTLE

- New generation of big.LITTLE based systems built on DynamIQ technology
- DynamIQ big.LITTLE systems:
 - Expands into markets beyond mobile
 - Higher product differentiation
 - Improved energy efficiency
 - Increased user experience (UX)
- Software compatibility
 - DynamIQ big.LITTLE is supported by Energy Aware Scheduling (EAS)
 - Contains support for DynamIQ features



technologies such as Dynamic Voltage and Frequency Scaling (DVFS) aim to scale clock rates and core voltages as the processing load varies to improve that efficiency, but DVFS doesn't overcome a fundamental problem with the building blocks of all CPUs – the transistors that make them work.

Why performance and efficiency can't mix

In digital circuitry, a transistor acts as a controllable electronic switch

ARM came up with big.LITTLE in 2011 to address 'performance vs efficiency' issues.

that has two voltage states – 'on' and 'off' – and it's this simple binary existence that has enabled designers to combine billions of them into CPUs that perform our modern-day miracles. The problem here is that transistors suffer from various forms of 'leakage current', which, put simply, is electrical current that drains through the transistor and is wasted – think of it as buckets with tiny holes.

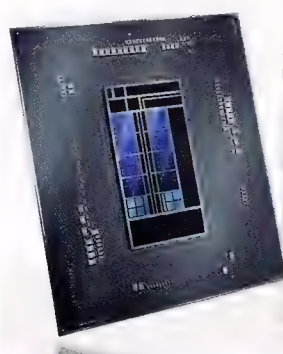
This transistor leakage current is tiny, but when you multiply it out by the billions of transistors in new CPUs, it quickly adds up. Shrinking the transistor size, as we've been doing for years, also doesn't help here – in fact, it makes things worse.

Big and LITTLE ARMs

Take a look at any laptop or desktop CPU over the last 15 years and you'll find homogeneous multi-core designs everywhere – all cores inside a particular chip are identical. Most of what we do today just isn't possible without multiple CPU cores crunching the numbers, but it was mobile chip designer ARM (now

Intel's new Alder Lake chips will feature two CPU core types in the one package.

Below: Intel's new desktop CPUs come with and without integrated graphics.



Introducing

Alder Lake

Reinventing Multi Core Architecture

Single, Scalable SoC Architecture

All Client Segments – 9W to 125W – built on Intel 7 process

All-New Core Design

Performance Hybrid with Intel Thread Director

Industry-Leading Memory & I/O

DDR5, PCIe Gen5, Thunderbolt™ 4, Wi-Fi 6E

Processor	Core count	Processor Threads	Turbo Frequency specifications			Base Frequency Specifications		Price (US\$ per 1k units)
			Turbo Boost Max 3.0 Frequency (GHz)	P-core Max Turbo Frequency (GHz)	E-core Max Turbo Frequency (GHz)	P-core Base Frequency (GHz)	E-core Base Frequency (GHz)	
i9-12900K/KF	16 (8P + 8E)	24 (16P + 8E)	Up to 5.2	Up to 5.1	Up to 3.9	3.2	2.4	589/564
i7-12700K/KF	12 (8P + 4E)	20 (16P + 4E)	Up to 5.0	Up to 5.1	Up to 3.8	3.6	2.7	409/384
i5-12600K/KF	10 (6P + 4E)	16 (12P + 4E)	N/A	Up to 4.9	Up to 3.6	3.7	2.8	289/264

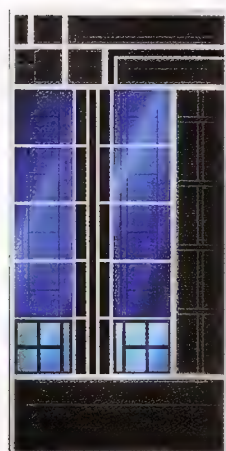
NOTE: K-models include integrated graphics, KF-models do not.

owned by Nvidia) who first made 'mainstream' nearly a decade ago the solution Intel is set to embark upon.

Instead of each chip featuring identical cores, ARM developed a platform that allowed chipmakers to combine what it called 'big' and 'LITTLE' cores into the one package, creating a heterogeneous collection where 'big' cores delivered processing performance and 'LITTLE' cores concentrated on power efficiency. Samsung's 2013 Galaxy S4 phone was one of the first to feature this 'big.LITTLE' architecture with four 1.6GHz 'big' Cortex-A15 and four 1.2GHz 'LITTLE' Cortex-A7 cores under the bonnet. Here, the Cortex-A15 cores did the heavy lifting and the Cortex-A7s kept everything going with a minimum of electrical power.

Today, DynamIQ has taken 'big.LITTLE' to the next level and you'll see it in most of today's top-drawer Android phones powered by various combinations of Cortex-X1/X2, Cortex-A77/78 and Cortex-A55 core designs, but with the same 'performance vs efficiency' game plan still in play.

All of these CPU core groups can run the same code, but with the lower-power cores having fewer transistors, they execute the code at a slower pace. However, the key is that by having many fewer transistors, the leakage current in these low-power cores is substantially reduced. The operating system kernel has charge of deciding which cores are used based on the load type – for example, if it's gaming, the performance cores stand up, but if it's playing music, the power-efficient cores take over and get the job done.



Alder Lake Core/Cache

Up To

16 Cores

8 Performance
8 Efficient

Up To

24 Threads

2T per P-core
1T per E-core

Up to

30 MB

Non-Inclusive
LL Cache

Alder Lake will process as many as 24 threads with its Core i9-12900K/KF series.

Intel's heterogeneous setup

This is what makes Intel's move a major step in PC evolution. Alder Lake chips will for the first time feature two core groups – 'Golden Cove' performance or P-cores and 'Gracemont' high-efficiency or E-cores. According to reports, all Alder Lake 'Core' chips will feature as many as eight E-cores, while the number of P-cores will vary depending on application – up to eight on desktop, six on laptop and two on ultra-portables. Hyper-threading still makes an appearance but only on P-cores.

The newly announced desktop chips include the i5-12600K/KF with ten cores (6P + 4E), i7-12700K/KF with 12 cores (8P + 4E) and the i9-12900K/KF with 16 cores (8P + 8E). The K-suffix chips have integrated Intel graphics, the 'KF' chips don't. We've included a table to give you an idea of the base/turbo clock rates of the new chips.

However, what is interesting is that the base core clock speeds increase the further you go down the chip line – the top-drawer

16-core i9-12900 has P/E base clock rates of 3.2/2.4GHz, whereas the more economy i5-12600 line with its 10-cores has 3.7/2.8GHz base clocks.

While there was no local pricing at time of writing, Intel's wholesale (1000-minimum order) US pricing suggested the mid-range Core i7-12700K/KF chips could be the 'sweet spot' – closer to the i5-12600K/KF in pricing, but closer to the i9-12900K/KF in P-core performance.

Apple shocked many when its M1 Max CPU powered ahead of Intel's equivalent in performance testing, but early reports suggest Alder Lake will restore Intel's pride by regaining top spot on the mobile speed ladder, but only just. Nevertheless, given the laptop-focussed Core i9-12900HK is said to have 14 cores to play with and the M1 Max just 10, deciding who has the better tech will likely come down to more than just 'straight-line' speed.

Alder Lake and Windows 11

ARM 'big' and 'LITTLE' core operation is controlled by the operating system kernel. However, Alder Lake will incorporate Intel's new 'Thread Director' tech, which, in combination with the new Windows 11 OS, will determine which code thread heads to which CPU core type.

At this stage, we still have many more questions than answers. For instance, it's not clear how the E-cores perform, both in processing and power efficiency, nor what effect they'll have on battery life. However, you can be sure the combination of new Intel tech and Microsoft Windows 11 will kick-restart PC sales just in time for Christmas. ■

Below left: Gigabyte's Z690UD motherboard with its LGA1700 CPU socket.
Below right: Among Asus's new motherboards is the ROG Strix Z690-A gaming board.



MACHINE OF THE MONTH

MSX2 (1985)

The popular Japanese MSX received a hefty performance boost.

John Knight

This month, we head back to Japan to revisit the MSX standard with its 1985 sequel, the MSX2. While the original MSX machines were fairly middle-of-the-road 8-bit microcomputers, the second-generation version gained a big jump in performance. The MSX2 introduced key improvements to the base RAM (64K to 512K), video memory (64K to 128K, with higher resolution, more colour, and support for vertical scrolling), and sound chip specifications. For fans of the Sega Master System and Nintendo Famicom (NES), MSX2 computers provide a genuine alternative that will make any Japanese game geek salivate.

A powerful update

The MSX was a standard for 8-bit microcomputers developed by Microsoft Japan in cooperation with the ASCII Corporation. If every MSX computer had a set of standardised components, software written for one should, in theory, work on any other.

Specifications

CPU: Zilog Z80A @ 3.58MHz **VRAM:** 64 to 128KB **RAM:** 64 to 512KB (more RAM is theoretically possible) **ROM:** 48KB BASIC **Graphics:** Yamaha V9938, 512x212 with 16 colours from 512, or 256x212 with 256 colours, 32 sprites with 16 colours **Sound:** Yamaha YM2149 PSG **Storage:** Cartridge, cassette, 5.25 and 3.5-inch floppy add-ons **OS:** Microsoft MSX BASIC 2.0 and MSX-DOS 2.0 **Released:** May 1985



Metal Gear (1987) on the MSX2 marked the true beginning of the series. The famous Nintendo version was made by a different team and had no input from the original creator Hideo Kojima.

With better video processing, MSX2 gaming was much improved.



In May 1985, the MSX2 standard was announced, bringing a substantial performance, but remaining backward compatible with the MSX.

While the new MSX2 standard was designed by the ASCII Corporation, Microsoft continued their software support for the system with MSX-DOS 2.0, which came on a separate cartridge and closely resembles MS-DOS 3.3. Curiously, the MSX2 uses the same 3.58MHz Zilog Z80A CPU found in the original MSX – its substantial power gains come from its other components. Where the old MSX usually had between 32-64KB of RAM (8KB minimum), the MSX2 starts at 64KB, with other models ranging from 128KB to 512KB.

You'll need this

- An internet connection
- A decent browser
- Get openMSX at openmsx.org or WebMSX at <https://webmsx.org/>

Video processing was enhanced with its new Yamaha V9938 VDP. This 21MHz powerhouse was usually coupled with 128 KB of VRAM, allowing 16 colours from a 512 colour palette @ 512 x 212, or 256 colours @ 256 x 212. Sprite handling is especially improved with a maximum of 32 sprites on-screen using 16 colours.

Sound received a minor upgrade with the Yamaha YM2149 sound chip, a clone of the General Instruments chip found in the MSX with small improvements. However, in 1986 Konami, in collaboration with Toshiba, released the SCC "Sound Creative Chip" – a much more advanced chipset. Although it was originally used only in game cartridges, clever workarounds spawned a new scene of demos, music disks, and sound utilities.

Gaming

On the whole, MSX2 gaming is an impressive experience, with graphics, sound, and gameplay that often exceeds the kind of gaming found on the Master System or NES.

However, MSX2 machines have a strange Achilles' heel: they don't have hardware-assisted four-way scrolling, which was essential for the kind of 2D platformers and RPGs that eventually ruled in the 1980s.

This often resulted in a strange gaming experience, where graphics were often sharper and more detailed than anything from Sega or Nintendo, but many games used simple flick-screen designs, as found on an Amstrad or ZX Spectrum.

Nevertheless, the MSX2 provides some brilliant gaming, especially for

Konami fans. Of particular note are the first two *Metal Gear* games, which are the real first two installments, not the games released by Nintendo.

Some other famous Konami titles include *Vampire Killer* (1987), a variant on *Castlevania*; an enhanced version of *King's Valley II* (1988); and *Space Manbow* (1989), a sophisticated scrolling shooter with impressive story animations.

Beyond Konami's range, other noteworthy titles include *Shin Maou Golvellius* (1988), *Psycho World* (1988), *Aleste* (1988), and *Aleste 2* (1989).

Legacy

Although Japanese sales went well, the concept did not become the worldwide standard Microsoft had planned. Microsoft pulled out of the MSX project in 1986, leaving the ASCII Corporation to continue alone. With all the different manufacturers worldwide, researching MSX sales numbers produces wildly varying figures, from estimates of 5 million sales worldwide to 9 million in Japan alone.

In 1988, ASCII updated the standard with the MSX2+, which upgraded the video processing, allowing 19,268 colours instead of 512. An FM-PAC cartridge was also included, with better audio and more sound channels. The MSX2+ was only available in Japan and Korea. The series ended with the TurboR in 1990: a 16-bit machine that wasn't fully backward-compatible with the previous

generation, and only produced by Panasonic.

Emulation

When we covered the original MSX, we chose openMSX as our preferred emulator, but we'd now recommend WebMSX. Although we wouldn't normally choose browser-based emulators, WebMSX is solid and doesn't require system ROMs.

If you would still prefer an offline application, see our March 2021 issue, which has instructions for openMSX. Both WebMSX and openMSX have MSX2 support, but WebMSX is easier to use.

To get started, just visit webmsx.org and WebMSX will load a BASIC prompt, ready to run anything you like (if a file is compressed in ZIP format, you can open it without extracting it).

Loading cartridges

Cartridges are the easiest format to use. To load a cartridge file, either click the "load files" link or drag and drop a file onto the browser window. Or load the cartridge manually by clicking one of the icons at the bottom of the WebMSX window, and choosing 'Load ROM Image' from the pop-up menu.

The emulator will reset and load straight from the cartridge. If you're finished with your cartridge and want to perform other tasks, use the cartridge menu to remove the image.

WHERE DO I FIND SOFTWARE?

There are a fair few ROM sites out there but, unfortunately, we can't recommend them for legal reasons. However, the two best sites you can use are msx.org and msxgamesworld.com, which have extensive archives (including demos and public domain software, which is something we can legally recommend).

New games are still being made for all MSX systems. One good source is www.retroworks.es. We liked *Sword of Ianna* (2017), with *Prince of Persia* style gameplay in a barbarian RPG setting, and *Knight Lore Remake* is a visually impressive remake of an isometric puzzle classic.

Loading disks

It's worth browsing the disk menu. Other than "Load Disk Images", you can "Add Boot Disk" or "Import Files to Disk". Unlike cartridges, simply loading a disk won't do anything, but don't panic. Most disks have an MS-DOS style autoexec. bat (or .bas) file. Reset the virtual MSX by clicking the Power icon, followed by Reset, and most disks will boot automatically.

Loading cassettes

Before loading cassettes, some programs display an error, asking you to remove the disk drive.

To do so, click the Settings icon at the bottom-right of the screen. Near the top of the menu is the option "Floppy Drives". Click this twice, and the icon will turn from red to grey. This disables your floppy drives – clicking the icon until it's red again will re-enable them.

To load a tape, follow the same instructions as with disks or cartridges. Like disks, nothing will happen initially – you need to manually load the program. Click the tape icon at the bottom of the screen, and from the pop-up menu click "Run Program".

Tweaking webmsx

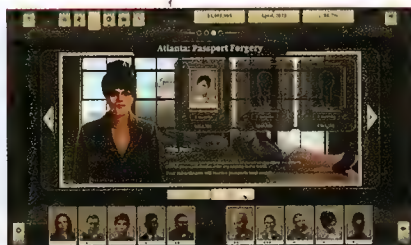
Sooner or later, you will need to tweak WebMSX's settings for an application to work properly.

Some games such as *Metal Gear* require a Japanese system, but the default system is an American MSX2+. To use a Japanese system, click the Settings icon and choose "Select Machine". This will provide a list of different machines from around the world, including systems from every generation of MSX.

Some applications require the SCC sound cartridge. This is enabled simply by clicking Settings, then selecting "Konami SCC+" from the pop-up menu. ■



Capcom was another famous MSX publisher. *Higemaru Makaijima: Nanatsu no Shima Daiboken* (1987) is a hidden gem for anyone into swashbuckling pirate adventures.



NEW TYCOON GAME LETS YOU BE A FAMILIAR CORRUPT POLITICIAN

This is the President is unambiguously a satire of the Trump administration.

Set to release on December 7, *This Is the President* is a satirical, story-driven game where you take the role of a "newly elected leader with a shady background." That could be any number of leaders, but the game description goes on to narrow it down: you're a "multi-millionaire businessman" who gets their own way by "persuading, blackmailing, bribing and bullying a large part of the political system into granting you lifelong immunity."

It's an interesting hybrid of visual novel and grand strategy, and should appeal to anyone who has had dreams of becoming a ruthless, monomaniacal president with a proclivity towards hired assassins. It might even appeal to many who haven't.



2K GAMES CANCELLED UNANNOUNCED GAME WORTH \$53 MILLION

That's a lot of wasted money and time.

During an earnings call last month it emerged that publisher 2K Games has cancelled a long-in-development game by *Mafia 3* studio Hangar 13. The project, which has accumulated a sunk cost of \$53 million, was reportedly an online superhero game that had gone through multiple iterations before finally being cancelled. The lack of a clear direction, as well as the COVID-19 pandemic, led to its demise.

Hangar 13 is best known for the aforementioned *Mafia* installment but the studio – which has offices in the Czech Republic, California and England – also worked on the *Mafia* remake, and is big enough that it is probably also working on a whole new game in the crime series.



GTA Trilogy Definitive Edition missing much-loved music

Has music licensing killed 'Video Killed the Radio Star'?

Based on the tracklist Rockstar has provided, while all of *GTA 3*'s original music is preserved, over 40 songs from the original versions of *Vice City* and *San Andreas* are missing from the upcoming Definitive Edition. As such there will be no cruising around *Vice City* listening to Gary Numan's 'Cars', or hearing Rage Against the Machine's 'Killing in the Name' blare out of your speakers in *San Andreas*.

Oddly, 'Fist Fury', a song recorded for the *Vice City* soundtrack and attributed to the fictional band Love Fist, isn't on the list. Gone from *San Andreas* is George Clinton's 'Loopzilla', which once played on Bounce FM, though you'll still be able to hear Clinton DJing that station as "the Funktipus". 'Rock Me Again and Again' by Lyn Collins will apparently no longer be heard on *San Andreas*'s rare grooves station Master Sounds 98.3, though 'Think (About It)' by Lyn Collins does remain on the list.

There will be no cruising around Vice City listening to Gary Numan's 'Cars', or hearing Rage Against the Machine's 'Killing in the Name' blare out of your speakers in San Andreas

NEW BETHESDA RPGS WILL FOCUS ON DEPTH AND IMPROVED AI

Todd Howard speaks on Elder Scrolls 6 and Starfield.

Skyrim turned 10 last month, and despite being a bit long in the tooth it's still arguably the best Bethesda Game Studios RPG of the century. The wait for its follow-up – known only as *The Elder Scrolls 6* at this stage – is still a way off: as of June it was still in its "design" phase and besides, *Starfield* is set to release in November next year.

A new IGN interview with director Todd Howard provides some small hints regarding the studio's priorities for advancing their RPG design, and it's not just prettier graphics: Howard wants to make them more complex.

"There are a number of parts of it where we don't go deep enough, where it's a veneer in terms of its interactivity," Howard said when quizzed on what the studio could have done better when developing *Skyrim*. "Look, you can say that about anything, but I think when we think about games and what we want to do going forward, ok, whatever that system is, how deep can we make it? The other part is the way the AI and NPCs really react to you – I think we have a long way to go with [that]. Those are probably the main ones."



GOD OF WAR IS COMING TO PC IN JANUARY

Sony's tale of gods, monsters, and parenthood is listed on Steam now.

"We're thrilled to announce that *God of War* (2018) will be coming to PC on January 14, 2022!" Sony Santa Monica Studio senior community manager Grace Orlady wrote on the PlayStation Blog. "All of us at Santa Monica Studio have been humbled by the immense amount of support and passions fans of the *God of War* series have shown in the latest chapter of Kratos' story since its release. As of August 2021, 19.5MM copies for *God of War* on PlayStation 4 have been sold through and we can't wait to share that experience with a whole new group of players on PC."

Make no mistake, this is a very big deal. Sony has previously expressed interest in bringing more of its first-party games to PC, and has recently committed to some big ones including big names like *Horizon Zero Dawn* and *Uncharted 4*. But *God of War* is not just another PlayStation game – it's a capital-P "Prestige" title that's won numerous acclaim and awards for both its axe-swinging action and its effective portrayal of fatherhood and family.



RAINBOW SIX EXTRACTION MAY BE OUT JANUARY 20

Ubisoft's own blog post about *Extraction's* gameplay debut from June has been quietly amended to give a release date of January 20. Presumably this bit of housekeeping was supposed to happen at the same time as a more official announcement, but Ubisoft has yet to make one. *Rainbow Six Extraction* lets you choose from 18 *Rainbow Six* operators to take on alien Archæans over 12 maps.

BUNGIE SAYS NEXT YEAR'S DESTINY 2 DUNGEONS WON'T BE INCLUDED IN THE SEASON PASS

The game's convoluted monetisation model is under the microscope again.

Technically Bungie announced this back in August, when it revealed *The Witch Queen* expansion. The two dungeons are available as part of the *Deluxe Edition* version of *The Witch Queen*, listed as a separate perk from access to the year's season passes. Nevertheless, by not outright saying that the dungeons weren't included, many assumed the opposite to be true.

The clarification finally came from *Destiny 2* community manager Cozmo23 in a heavily downvoted Reddit comment. "We've seen some debate around the new dungeon content and wanted to clarify how it will be delivered next year," he wrote. "If you get the *Digital Deluxe Edition* of *The Witch Queen* you will receive the expansion, all four Seasons for the next year, and the two Dungeons. If you get the *Standard Edition*, you can still upgrade to the *Deluxe Edition* to get the dungeons later. We will also be offering a separate way for you to purchase the Dungeons in the future, but they will not be included in the Season passes."

EA CALLS NFT AND BLOCKCHAIN GAMES 'THE FUTURE OF OUR INDUSTRY'

EA CEO Andrew Wilson called NFT and "play-to-earn" games the "the future of our industry," but added that "it's still early to figure out how that's going to work," when asked about the topic during the company's earnings call this week. "I think that in the context of the games we create and the live services that we offer, collectible digital content is going to play a meaningful part in our future," Wilson said. ■



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Far Cry 6

Demonstrates why the series needs a revolution of its own.

Ubisoft is determined to make Giancarlo Esposito's *Far Cry 6* despot, Antón Castillo, feel like a real and credible threat, he's more of a satirical mash-up of Franco and Castro. He's definitely a bad guy, with a vision for his country that he holds above all – even family, as he often reminds his son and protégé, Diego – but there's a two-dimensional vibe I just can't shake.

Far Cry 6 is a quintessential *Far Cry* game. You begin as an underdog who quickly ends up with the moniker of hero, fleeing some tyrannical bastard who's wrecking the lives of the locals to make his dream a reality. In this case, he's made a smokable cancer cure, Viviro. Viviro is farmed and produced by slaves from Yara. Castillo labels them as 'outcasts' and 'fake Yarans', setting the us-and-them tone in the game's opening sequence. Much like its predecessors, you can grapple your way up cliffs and buildings, use your phone to track enemies and their weaknesses and, for the first

time, simply holster your weapon so you don't look super sus running around with a sniper rifle.

Ubisoft has borrowed the cloaked mechanic from *Assassin's Creed* in the sense that as long as you and your holstered weapon don't stand too close to guards or act in a suspicious way, you can pass through checkpoints with no violence. It also works as a stealth mechanic, where you can saunter up to a vehicle, quickly whip your pistol out and assassinate the driver before stealing a prison truck.

Far Cry 6 does at least give you one major game changer: the Supremo. The Supremo is like an ugly back bling that brings way too much power to a fight. You can combo it with a weapon to inflict terrible damage on your opponents as you see fit. You'll begin with a flamethrower and rocket launcher combo that's just as stupid and OP as it sounds.

There are other silly yet effective weapons available in-game, too, like the CD Launcher that



Top: Ka-boom!
Above: Dani, please be serious.

questionably blasts the Macarena. Overall, the combat is as good as it's ever been. You can sneak your way around and take out enemies with melee kills or headshots, or go in all guns and Supremos blazing.

It wouldn't be a *Far Cry* game without a few twists, though I'll leave this review spoiler-free. Betrayal is at the heart of *Far Cry 6*, from Castillo's deception to the world about how Viviro is grown and manufactured, to the grievances within the guerrillas and Dani's own relationship with the regime.

There's little to laugh at with *Far Cry 6*'s story, instead leaving a sour taste as you wonder about reality and the state of the world. And for that, I definitely recommend you play it.

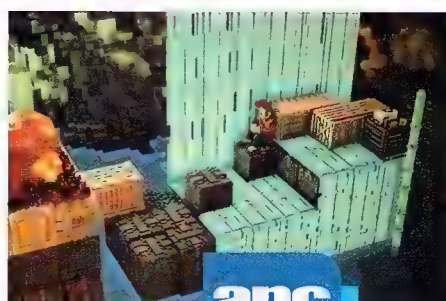
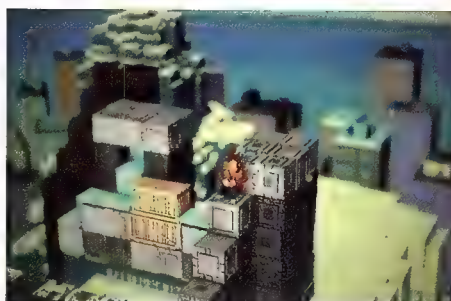
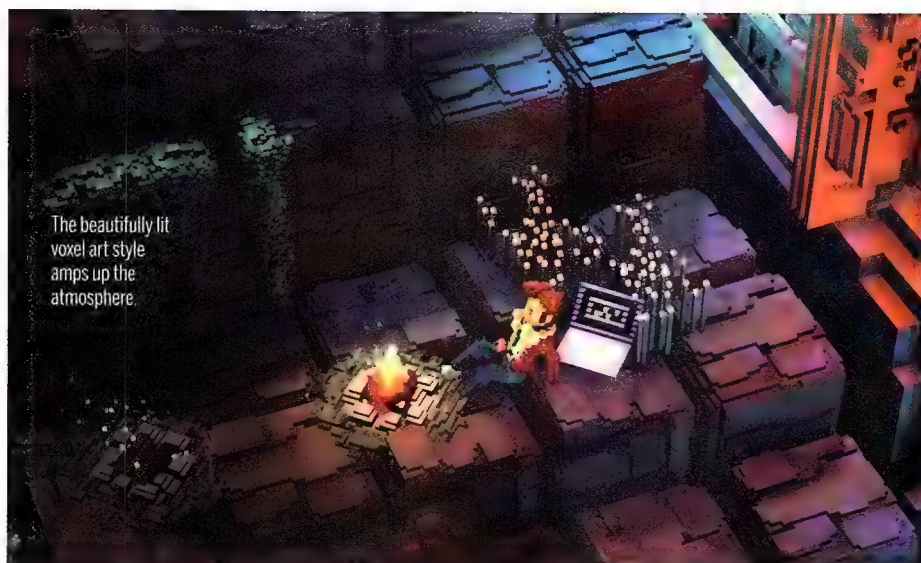
Yara is super lush and wonderful to explore, but unfortunately it's all a little too familiar – both in gameplay and story.

Lauren Aitken

★★★★☆

Please meet the travel rep at 8am...





\$28.95 | bonfirepeaks.com | PC, PS4/5, Linux, Mac, Switch

Bonfire Peaks

Leaves plenty to think about – and to burn.

The *Bonfire Peaks* setup is simple. Our unnamed protagonist has left for the woods to burn all his possessions, and it's your job to push, drop, or slide the crates of his belongings into a fire. In this block-y, voxel world, you can only move forward, backwards, or pivot on the spot. Any block you're holding will swing round as you turn too, so space is key. Early puzzles set the stage simply on how to navigate and manipulate that space – like how to be sure to climb stairs backwards, so you don't brick yourself in.

As *Bonfire Peaks* progresses, it introduces new elements – longer bricks, conveyor-belt like streams, and Indiana Jones-esque pressure traps among them. Unlike the smooth onboarding at the start of the game, the introduction of these complicated puzzle elements can feel disruptive.

The puzzles in *Bonfire Peaks* are tricky. They're full-on headscratchers, and failing a few times is a necessary part of troubleshooting your way through to the correct approach. So building a rubbish bridge didn't immediately signify that I wasn't supposed to be building a different, better bridge – I just

thought my bridge was bad.

Bonfire Peaks' care to neither frustrate nor condescend contributes to its meditative feel. You only need to complete a few puzzles per zone to progress. It's a quick tap of a button to undo a careless mistake – or to capitalise on one that triggers an 'aha' moment – and you can undo your way all the way back to the beginning of the puzzle, if you so choose. It's a careful balance to keep you in your element.

Any individual puzzle in *Bonfire Peaks* is good – brilliant, actually – tightly crafted, using every part of a puzzle map for necessary bottlenecks, obstructing height, or escalating stairways precisely as needed. Its world is beautiful, and as a collection of puzzles, it's incredibly smart. If only its uneven progression and self-conscious story additions didn't make for as rough a climb.

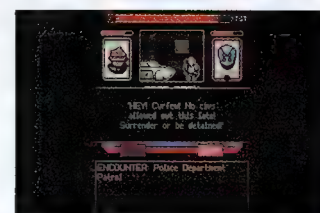
Charming – but without establishing its tricks, it risks leaving less fluent puzzlers behind.

Ruth Cassidy

★★★★☆

Above left: The view from my failed ascent. So close, and yet, so far.

Above: You have to sit under waterfalls.



Free | hwilson.itch.io/vespiary
PC

VESPIARY

Puts the deck in Deckard.

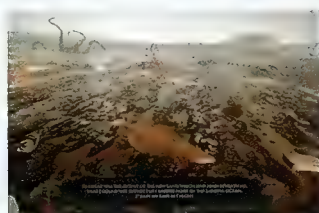
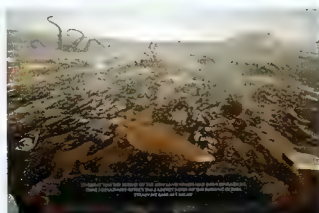
Vespiary is set in the gritty cyberfuture. The streets are packed with cyberscum, and it's up to you – as one of three bounty hunters – to clean it up, one crime boss at a time. Essentially, you hop between randomly ordered events until you reach the boss and beat the scenario. Events include vending machines and traders, cops demanding ID, and violent gangs. Combat is turn-based, but not strictly 'I go, you go', as you can choose to use all four cards in row. Not all will likely be weapons, but you may want to chug a healing potion, or throw an unneeded ID card at the enemy. It's worth a shot, as this frees up a slot for another card.

However, after every action of yours, your opponent will sneak a token into that free slot. This initiates the enemy's turn, during which they'll launch an attack on you. After, you'll regain the slot, and can click the 'Find' button to scrounge up a random card. So it goes, turn by turn, until the battle is won.

It's original, and I love the gritty, futuristic setting. But *Vespiary* was too easy to keep me engaged.

Tom Sykes

★★★★☆



Free | bit.ly/2Zwf15t | PC

DAGON

A slick Lovecraft adaptation.

Dagon retells the Lovecraft short story word for word. While the narrator relates his dreadful tale, the player is free to look around each scene and hunt down a collection of optional trivia. It's only nominally interactive, but the sights do justice to the deliciously wrought text, as the POW protagonist escapes his captors only to arrive on an ocean floor that has risen to the surface, ancient fishy horrors and all.

Dagon is an early and very brief short story that contains the mythos in a prototypical form. The game embellishes it with strong voice acting and slick slideshow art assets that support the text rather than overpowering it. I lingered in each scene, once the narration was done with it, taking in the atmosphere and searching for collectibles. These pickups essentially act as a director's commentary, not just on *Dagon*, but on Lovecraft as a whole. Did you know he hated fish, for example? Well, of course he did. Ol' Howie was also dead against booze.

Probably the most authentic adaptation of an HP Lovecraft story yet

Tom Sykes

★★★★☆



\$44.99 | jett.fyi | PC, PS4/5

Jett: The Far Shore

Superbrothers returns with another poetic adventure.

Above: The scout's homebase, it's prettier on the inside.

Above right: Mei has cryptic visions – don't ask me what they mean.

Jett: The Far Shore starts off as a familiar sci-fi tale. Humans have messed up the planet and in desperation to save civilisation must now look for a new home amongst the stars. The trope has been done to death, but in *Jett* it's different. The humans are not only looking for somewhere to live, but have been contacted by 'the hymnwave', a divine invitation from a being situated on an alien planet. Desperate to escape their dying world, a group of space scouts is formed to head out into space and see whether this strange planet – dubbed 'the far shore' – could become a viable new home for the human race.

You play as Mei, a scout pilot who has been chosen to be part of the team. After arriving on the planet, early game tasks are all about exploration. Driving a nippy little ship called a 'jett', you need to observe the planet's ecosystem and gather data. Your jett is equipped with tools to help you research, including a scanner, flashlight, and grappling hook, and as you cruise through the landscape you can scan different vegetation and animals to see how they behave and fit into the wider ecosystem. It's a little

tedious, but *Jett's* alien landscape makes you want to do the research.

This mysterious planet is home to huge lakes, endless pink meadows, and vast, purple plains. There are plenty of weird ways to experiment and explore, such as hovering your jett over various plants and using the boosters to 'pop' them, unleashing waves of colourful spores. It's fun to discover these little surprises but, unfortunately, it's made less appealing by the flying controls, which can be fiddly at best, and frustrating at worst.

There are plenty of dramatic encounters where you have to zip away from flying perils, and when these events happen in open waters or in expansive plains they're nothing short of thrilling. Darting across the sea trying to outpace a red haze that's cast down from a blood moon was one of the game's many highlights.

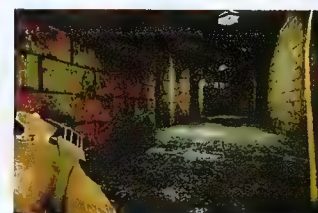
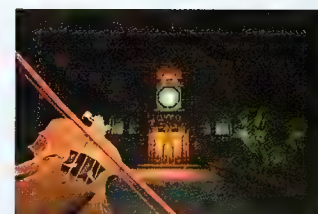
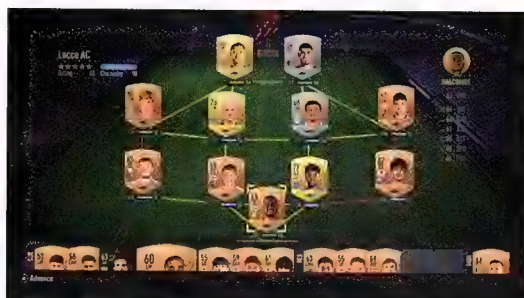
Has some epic highs but fiddly ship controls and unanswered questions bring it down.

Rachel Watts

★★★★☆



Tifo at the Volkswagen. Or as normal people call them, flags.



\$79 | ea.com/games/fifa/fifa-22 | PC, PS4/5, XBS/X, XBI

FIFA 22

Jogo Bonito hasn't changed much, but it's enough.

If you love football, in whatever hue or flavour, *FIFA 22* should be part of your life. It recreates everything special about the game – but also its greed and superficiality, encapsulated by FIFA Ultimate Team (FUT).

Want to assemble your very own Galácticos? Then FUT delivers. Create that team of GOATs by slow grind, or real-world money, and challenge the world. This time there are returning greats and a new Elite Division. The challenges are fun, until you notice that advancement is glacial.

It's a loot box economy and a growing body of research states that there's a verifiable link with problem gambling. It's not the only loot box game in town, but it's the biggest and most profitable. *FIFA*'s reach, with 31 million players and an age rating of 3+, makes any deleterious effect significant. So, as it is, I can't recommend FUT. Don't play it.

The score reflects this, but *FIFA 22* without FUT is still vast and scrumptious. More Volta tricky street football, with bearable story mode and hysterical weekend party games. Co-op Pro Clubs,

kick-off quick games, House Rules, skill games, tournaments, and internationals. Something for even the dourest fan. At 45 hours in I feel like I've only scratched the surface. We aren't getting the HyperMotion tech like next-gen consoles, and I bristle that it's not available for top-spec systems, but I didn't notice at first. *FIFA* games look and feel amazing to play – half TV viewer, half participant, like you're there doing it, but talented.

Player Career Mode, where you take a youth with potential and aim for the top, now has skill points, perks, a skill tree, and giant floating objectives. The dressing room animations of your teen cradling a man-of-the-match trophy in disbelief are sweet, and the sense of accomplishment is real.

Gentle on the easiest difficulty, the challenge rises in satisfying steps. Ignore the faults and weave a narrative within it. That's what football really is.

Wonderful and distasteful all at once, it entertains and fails in turns.

Matt Killeen

★★★★☆

Above left: FUT is about to give me a CAM. I don't need a CAM. It's always Pogba.
Above: Volta. Football in yellow pyjamas.

Free | katanalevy.itch.io | PC

SYMPHONY OF SEVEN SOULS

Collecting spirits.

There's an art to creating a game without dialogue, narration, or any overt story to define what's going on, and *Symphony of Seven Souls* is a strong example of the form. The only text in the game is the title, and two simple instructions: right click to prep your violin, and hold left to make it play beautiful, context-sensitive music.

You're the game's composer as much as you're its main character, scoring a handful of locales – a gloomy church, a rain-drenched graveyard and hedge maze, a shadowy asylum that would surely house monsters in another horror game. Here you're alone – minus the hidden souls you've come to collect.

The seven souls only become visible when you are performing, however, so you're encouraged to play as you explore. I found half of the ghosts without really trying, while the others required tedious backtracking. Ultimately, the ending was worth it. I was poised to state this wasn't a horror game at all, but your final performance takes a darker turn that the violin is aptly equipped to soundtrack.

A game that lets you wield something other than a gun – to great result.

Tom Sykes

★★★★☆



GAME CHANGER

Portal

The cake is... far more sinister than you remember. By Ruth Cassidy.

RELEASE October 10, 2007 DEVELOPER Valve PUBLISHER In-houses LINK bit.ly/3DGTBRz

Portal has a place in gaming canon that makes it difficult to argue why you should replay it. Either you've played it, and love it, or you know what it's all about. It's like pitching somebody on watching the original *Star Wars* trilogy for the first time: we all know who Luke's father is. Its iconic moments are part of games culture – the companion cube is almost passé as a symbol of nerd culture, not quite old enough to be retro but old enough to be out of date – and 'the cake is a lie' was more thoroughly memed than 'taking an arrow to the knee' was for *Skyrim*. And in the meantime, plenty of other games have built on *Portal*'s 'thinking with portals' mechanics, from puzzlers like *Bridge Constructor* to shooters such as *Splitgate*.

That's before mentioning *Portal 2*, too, which expands significantly on what the original *Portal* introduces. About four times as

long with additional puzzle mechanics and a co-op campaign, *Portal 2* both gives us backstory on Aperture Science and GLaDOS, and introduces the highly quotable new characters of Wheatley and Cave Johnson. Johnson's speech about how 'when life gives you lemons, don't make lemonade, make life take the lemons back' may not have surpassed 'the cake is a lie', but it's printed on many, many tea-towels.

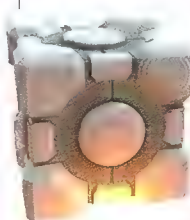
Why, then, play *Portal* now if its mechanics have been built on by newer games, and its most famous lines have been strip-mined for hilarity? Because, I argue, what *Portal*'s position in games canon belies is its effectiveness not as a puzzler, or a comedy, but in telling a horror story about powerlessness.

Test drive

Portal constantly plays with control – and how much or little of

it you have at any one time. As the game begins, you wake up in a small glass case which has no exit. All you can do is pick things up in your surroundings: a radio, a clipboard, a mug you can smash (which of course, I always do. Resistance may be futile, but I feel it is necessary). All the while, a camera is watching you – from outside your glass case prison – and a timer is ticking down, while a robotic voice welcomes you to the facility, explaining that "your specimen has been processed" and testing may now begin.

It's easy to forget, but the first tests don't even let you use the portal gun, instead forcing you to navigate around pre-set portals. Even when you do eventually gain full control of both the blue and orange portals, and it feels like the levels should have opened up to you, the level design still feels cold and hostile. You have to wait for platforms to come to you, for



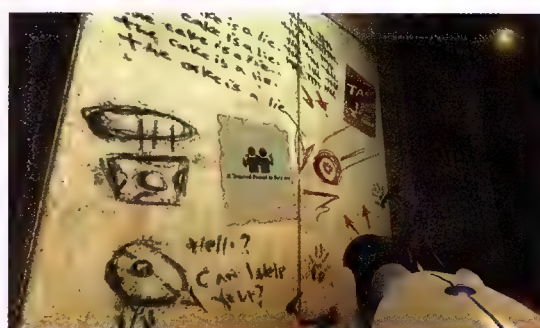
Right: 'Speedy thing goes in, speedy thing comes out.'



Left: You only ever get to see Chell through portals like this one.

Above: If you know, you know.

Right: The first of the refuges behind the walls.



timers to align, for energy pellets to traverse to their destination. Of course it's possible to play it fast – there are both speedruns for 'fastest times' and 'fewest portals' – but there are only set ways you can act on the world. You can press buttons, and you can shoot portals. Trying to rush parts of the test prematurely will at best fail, and at worst get you killed. The sense of only being a cog in a machine is oppressive – and while the messages are a little off, GlaDOS' presence early on is

implied to be that of a set of pre-recorded messages, simply representing Aperture Science. She's the robot you talk to on the telephone while trying to find a real agent, if that robot had the capacity to snipe at you as much as you might want to snipe at it. You're functionally alone.

Increasingly, it's not only the design of the tests that are hostile – in an interior design sort of sense – but the tests themselves. The floor in one will kill you, so you're warned to try to avoid it. Coming

into contact with energy pellets, which ping off at regular intervals, will also kill you. Turrets, armed with laser-sights, will certainly kill you – or at least leave blood splattered up the pristine white walls while you work out how to disarm them. All the while, GlaDOS offers unhelpful advice, but promises the reward of cake at the other end. Cake, and in one instance, grief counselling.

Even the interstitial spaces between levels are hostile, with the emancipation grills that dissolve any items you try to bring with you (and may emancipate your fillings, crowns, tooth enamel, or teeth), but also the lifts, which are notably lined with padded walls. Invoking psychiatric wards isn't my favourite visual shorthand in horror, particularly when some of the canon background lore for Aperture is clumsy in its depiction of mental illness. Regardless, the imagery is known across too much media to not understand the effect: it's medicalised, and it's isolating.

Cake boss

But of course, you aren't entirely isolated, because there's someone

END CREDITS

The voice of GlaDOS after Portal



LEFT 4 DEAD

After *Portal*, Ellen McLain took on the much more laconic but equally unsettling role of the witch in *Left 4 Dead*. The zombie is readily identified by her cries, and her ability to rip you to shreds when startled.



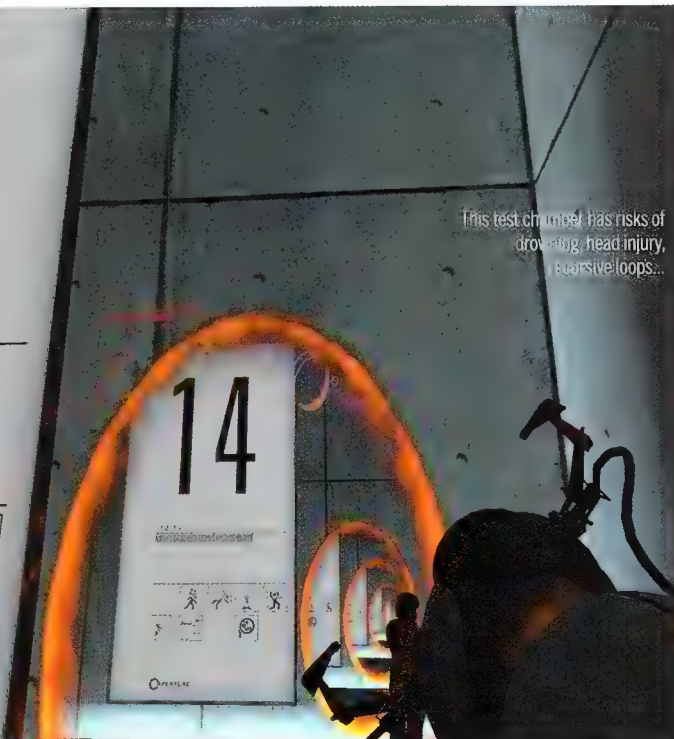
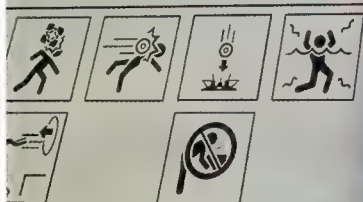
TURRET OPERA

McLain is also trained as an opera singer, and performed the aria sung at the end of *Portal 2*. While the music was composed by Valve composer Mike Morasky, McLain improvised the Italian lyrics.

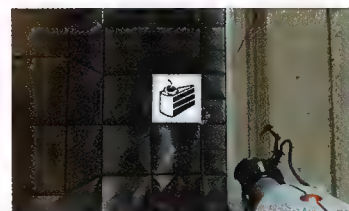
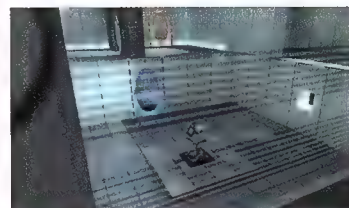


THE CHURCH IN THE DARKNESS

This sees McLain working alongside her husband and fellow actor, John Patrick Lowrie. The couple have also starred in multiple Valve games together – although not *Portal*.

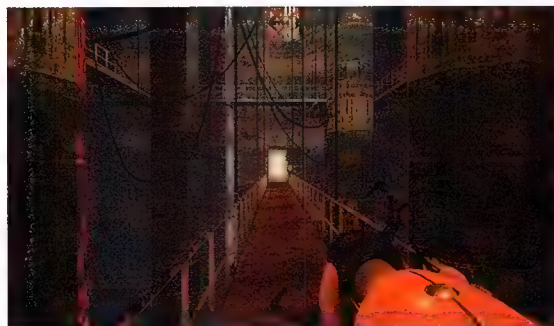


This test chamber has risks of
drowning, head injury,
poor loops...



Left: The
maintenance areas
of Aperture look
starkly different.

Above: Arguably,
there was cake.



living inside the walls, behind the test chambers. In contrast to the sterile, surveilled test chambers, the maintenance areas as you discover them are rusting orange and falling apart – not to mention covered in panicked graffiti. ‘The cake is a lie’, yes, but also plainly ‘help’, and if you hadn’t picked it up from all the cameras – and GLaDOS’s vocal dislike of having them destroyed – she’s watching you’.

It isn’t to suggest that whoever is behind the walls is themselves,

scary or threatening – but the implications of why they have to be there. What’s going to be at the end of testing? If there was going to be a way out of this, why is someone hiding from ‘her’? Exactly how malevolent is Aperture, and what are you supposed to do about it? Every handprint staining the wall, every scrawled ‘help’, is a disruption from the controlled environment of the testing chambers, and a reminder that indefinite testing isn’t normal or sustainable.

We remember GLaDOS as funny and mean, but she exists in *Portal* as a spectre of control. Many of her most absurd quotes (“That thing you burned up isn’t important to me... It made shoes for orphans”) are only when she’s desperately trying to regain it. Until then, she has the upper hand in every situation, and her lines speak of the chilling distance of someone with complete power over your life, but also very little interest in it. “This next test could take a very, very long time. If you become light headed from thirst, feel free to pass out.” They wouldn’t land the same without the context that also makes them sinister. It’s why, out of context, so many of the well quoted parts of *Portal* only feel like part of tiresome hashtag-random internet culture.

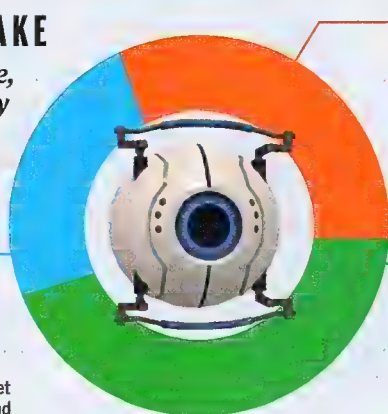
While GLaDOS’ jabs become gradually meaner from her telephone-tree persona at the start of the game, the progression from ‘this is an institution who doesn’t care about me’ to ‘this is a specific AI who personally hates me’ is marked. The shift from ‘we, Aperture’, to ‘I, GLaDOS’ only comes when GLaDOS drops the conceit and her narration becomes entirely unhinged. Even then, as

TRUTH CAKE

*A cake recipe,
as devised by
GLaDOS’s
intelligence
core*

**24%
DESIRABLE
IN A CAKE**

Ten ingredients
out of 42
Ingredients include
“one cup semi-sweet
chocolate chips” and
“four large eggs”.



**31%
TECHNICALLY
EDIBLE**

13 ingredients
out of 42
Ingredients include
“Fish shaped
crackers” and
“one tablespoon
rhubarb”.

**45%
HARMFUL TO
HUMANS**

19 ingredients
out of 42
Ingredients include
“Fish shaped ethyl
benzene” and
“needle gun”





The testing, the surveillance, and the battle for control don't only build to a sense of general dread, but one of institutional horror.

much as she insists on party and cake, there are still some chilling lines as you move beyond the purview of her all-seeing cameras. "I know you're there, I can feel you here."

The testing, the surveillance, and the battle for control don't only build to a sense of general dread, but one of institutional horror. Aperture could be a hospital, or a prison, and the trappings would barely change. But in them, Chell is an initially powerless individual, subject to the whims of someone with the authority to say "the difference between us is that I feel pain".

The atmosphere that *Portal* builds, and the shift between its first and second parts, wouldn't work without how well the puzzles are designed, either. Each testing chamber gradually teaches you how to intuit various skills. When you might need to use conservation of momentum to fling yourself to a great height or distance, or how to time portals to go around lethal obstacles, or even the simple

training to look for light tiles.

When you find yourself outside of the testing chambers, you're no longer being asked to test, and these abilities become survival skills. It's still all puzzle design, of course, but without the visual cues of test chambers – the step markers, the clearly marked entrances and exits – you're forced to think on your feet. If the first half of the game is hostile because the chambers feel designed against you, the rest of Aperture isn't designed for you at all.

Box art

Portal is funny. Glados is ridiculous, the jargon for 'cube' and 'button' is excessively over-the-top, and turrets say 'ow' when you knock them over. But it's as funny as it is because it goes to such dark places. *Portal 2* sets this darkness aside for more gag-based comedy and a jilted-ex dynamic with Glados – which I can appreciate on its own merits – but it also cements the *Portal*

series as one remembered for its comedy. In the years since its release, the details contributing to its atmosphere of oppressive discomfort are flattened.

In under three hours, *Portal* uses the time it has to not only teach you exactly how to play it, but also to notch up tension until the necessary moment where it breaks. It's effective for horror and a punchline both, with no room for emotional fatigue. It's worth reinstalling for that experience specifically: of a short, creepy game, that's clever and not bloated, and plays with the fine line between sinister and absurd.

Before booting it up again for this piece, I'd last played *Portal* only two years ago. Judging by my screenshot library – and memories of who exactly I've bullied into playing it – I've played it every two to three years since it was new to me. The puzzles are burned in muscle memory by now, but the interval is just enough time for any inoculation I had against the creepiness to wear off. 'The cake is a lie' might be a well-worn joke, but the help painted onto the floor in the same area is unsettling every time. ■

CHIP CHAT

JOEL BURGESS REPORTS ON THE UNUSUAL SIDE OF TECH NEWS

Angelina Lee
Software Engineer

Skills

Experience

415-812-3329
AngelinaTheDev@gmail.com
angelinathedevrecruiter.com

Experienced software engineer with a background of building scalable systems in the fintech, health, and adult entertainment industries. Expert in JavaScript, TypeScript, Node.js, React AI, Mia Khalifa, C++

Instagram / Senior Full Stack Engineer - Web App Team
October 2018 - PRESENT, Palo Alto, California

- Built [Linux](#) infrastructure using [React for AI on Blockchain](#)
- Optimized web app feed performance through new server-side [React](#) latency AI algorithm to quickly resolve big data pipeline
- Led team of 6 engineers to mine Ethereum on company servers
- Team coffee maker - ensured team of 6 was fully caffeinated with Antarctic coffee beans ground to 14 nm particles

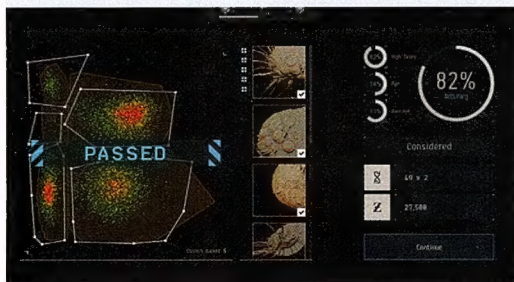
Zillow / Senior Full Stack Engineer - Web App Team
June 2015 - September 2018, San Francisco, California

- Added AI based GraphQL, resulting in 69% faster page loads

SOFTWARE ENGINEER CREATES FAKE RESUME THAT TRICKS RECRUITER SCREENING BOTS

All links lead to Rick Rolls.

Experience attributes like "Led a team of engineers to mine Ethereum on company servers" and "ensured a team of 6 was fully caffeinated with Antarctic coffee beans ground to 14 nm particles", aren't the kinds of things you would expect to win a job interview from if they were on your resume. Yet these exact points, and many others just as ridiculous, were enough for one software engineer to get a 90 percent response rate from Norton, ApartmentList, Quizlet, Outschoo, LiveRamp, AirBnB and Blend. Fed up with getting her real resume turned down, Reddit user u/AngelinaTheDev created this response to highlight issues with resume screening bots.



EVE ONLINE MINI-GAME SAVES COVID RESEARCHERS 471 HOURS OF WORK

Crowdsourced science in MMORPG makes meaningful contributions to Covid research.

As one of the longest running online community games, *EVE Online* has taken a lot of varied forms, but one of the more recent is a mini game called Project Discovery that's essentially a citizen science platform to study Covid-19. With 426,000 players collaborating on the mini-game the project has been able to complete 1.8 million analysis tasks since its launch in 2020. Recently the project was visually analysing the blood imagery of coronavirus patients to look for disease markers. The crowdsourcing process in Project Discovery has contributed an estimated 471 years of data crunching work to researchers.



Austrian museums create OnlyFans account after getting banned from social media

25,000 year old Venus of Willendorf statue is too risqué for social media.

After repeated instances of Facebook, Instagram and TikTok's AI screening systems flagging their exhibits as NSFW, The Vienna Tourist Board decided to open an OnlyFans account for uploading works from the Leopold Museum, the Kunsthistorisches Museum Vienna and the Albertina.

The museum's regular social media sites kept facing content strikes for "pornographic" content, so this seemed like the best available alternative to them. The tourist board is offering early subscribers free tickets to a museum of choice in order to see "Vienna laid bare" in person, too.



Clearview AI breached Australians' privacy

2 November 2021

Australian Information Commissioner and Privacy Commissioner Angelene Falk has found that Clearview AI, Inc. breached Australians' privacy by scraping their biometric information from the web and disclosing it through a facial recognition tool.

The determination follows a joint investigation by the Office of the Australian Information Commissioner (OAIC) and the UK's Information Commissioner's Office (ICO).

Commissioner Falk found that Clearview AI breached the Australian Privacy Act 1988 by:

- collecting Australians' sensitive information without consent
- collecting personal information by unfair means
- not taking reasonable steps to notify individuals of the collection of personal information
- not taking reasonable steps to ensure that personal information it disclosed was accurate, having regard to the purpose of disclosure
- not taking reasonable steps to implement practices, procedures and systems to ensure compliance with the Australian Privacy Principles.

The determination orders Clearview AI to cease collecting facial images and biometric templates from individuals in Australia, and to destroy existing images and templates collected from Australia.

Clearview AI's facial recognition tool includes a database of more than three billion images taken from social media platforms and other publicly available websites. The tool allows users to upload a photo of an individual's face and find other facial images of that person collected from the internet. It then links to where the photos appeared for identification purposes.

CLEARVIEW AI TOLD TO DELETE AUSTRALIAN'S DATA

Controversial facial recognition software deemed unlawful in Australia.

The Australian Information Commissioner and the Privacy Commissioner Angelene Falk announced through a statement in November that her department's investigation into Clearview AI, has found that the facial recognition software breached the Privacy Act 1988. The New York-based facial recognition startup pitched at law enforcement agencies is said to have breached local regulations around collecting sensitive information without consent and for "not taking reasonable steps to ensure the personal information it disclosed was accurate". The determination 'orders' Clearview AI to stop collecting Australian's facial and biometric data and delete any current database it has of local citizens. ■

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